The Magazine for Sinclair users and Timex/Sinclair users

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SYNC®

January/February 1983

Volume 3, Number 1

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Money Management
Loan Amortization
Checkbooks
Keeping Time

PROGRAMMING TIPS:

INTERP
CHR$, EDIT, LOAD,
RND, RAND

MACHINE LANGUAGE:

As Easy as 2 + 2

HARDWARE:

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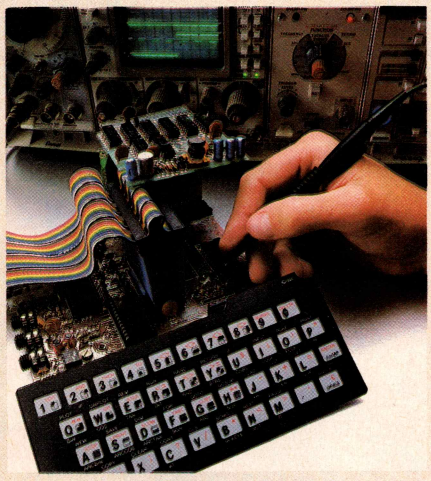

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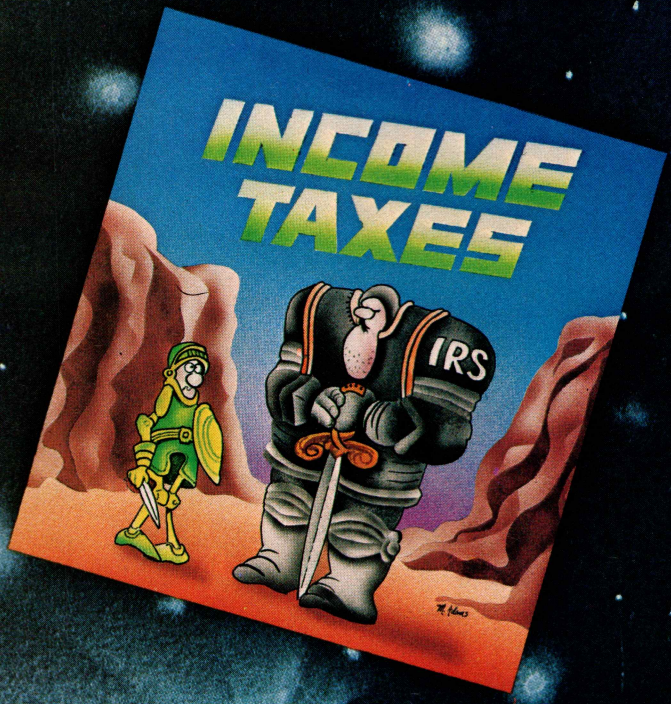

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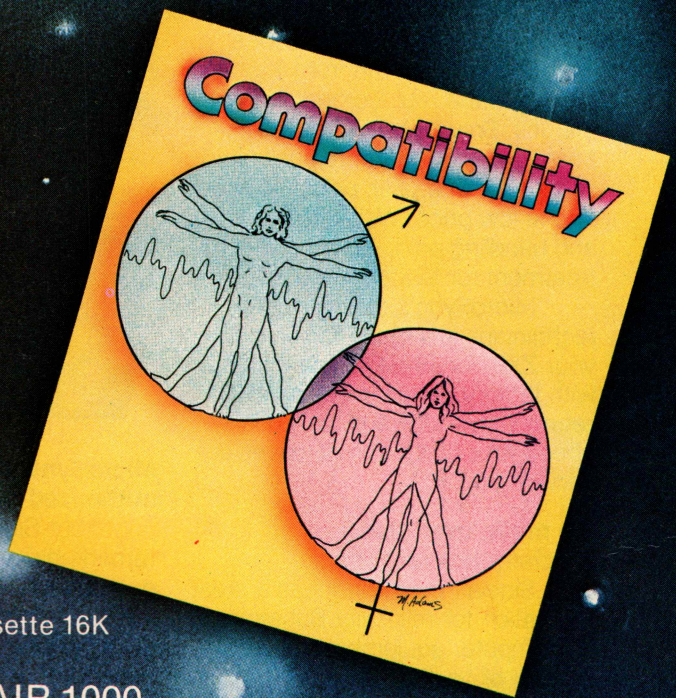

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Volume 3, Number 1

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letters

Help Wanted

Dear Editor:

I need some help with a MicroAce. The K inside the cursor keeps rolling and the unit will not respond to keyboard commands. I have attempted to troubleshoot it by chip substitution with no luck so far.

Peter Beck
54 Richwood Pl.
Denville, NJ 07834

Dear Editor:

I have noticed that saving programs on cassette from my ZX81 results in some buzzing sound which is recorded at the beginning and end of programs. Experience shows that this causes some problems when reloading the programs.

Is there any way or any hardware modification that will get rid of this buzz?

Ho Tiap Fen
PO Box 209
Bandar Seri Begawan
Brunei

New Product Problems

Dear Editor:

My first computer was, and still is, a 2K MicroAce. Now with the vast (relatively speaking) amount of peripherals available for the ZX81, I am seriously considering upgrading it significantly.

The problem, however, is that many of the ads in *SYNC* do not indicate whether or not the products are compatible even with the ZX80, let alone the MicroAce, even though they are all essentially the same machine with various internal differences. I realize that I will have to install an 8K ROM.

Please publish an article indicating what peripherals are directly compatible and what modifications can be done to adapt those not interchangeable between the ZX81 and the ZX80/MicroAce.

William E. Allen
2912 Metairie Ct., Apt. 24
Metairie, LA 70002

Ed.—Since the number of ZX81s out there is significantly more than the ZX80 type, most advertisers are naturally aiming at the larger market. If a ZX80 or MicroAce owner sees a peripheral or program of possible use, the best bet would be to contact the advertiser directly find out whether that product is compatible. We would welcome seeing an article providing the kind of analysis suggested.

Dear Editor:

Congratulations! It is good to see that someone has a magazine devoted to the Sinclair line of computers. Before I buy a computer though I want to know if it has programs to do what I want it to do. Do you know or can you find out if there are programs for: speed reading, analyze and predict the stock market performance of any particular stock, an electronic circuit designer, analyze and predict the winner of a horse race, and a program generator?

I need someone to give an impartial view. Can you?

Carlos Urrutia
RR4, Box 5A
Gregory, SD 57533

Ed.—Your best source of information on programs is our ad pages. Each issue brings new products as well as continued offerings of previous products. Through our reviewers we try to give a fair evaluation of products and programs. However, we have not run any reviews comparing programs for the Sinclair computer series with similar programs for other computers except perhaps as a point of reference. Help is on the way, though, because we are planning to publish a comprehensive buyer's guide for products for the Sinclair and Timex/Sinclair computers. See SYNC Notes in this issue for further details.

Dear Editor:

As the ZX81 becomes more popular, hardware and sofware from different vendors is flooding the market. Many perform the same function or offer the same type of software.

How is the average consumer supposed to know which product is best for his applications and which is the better buy if there is no information available?

In the near future does *SYNC* plan to give honest, in-depth reviews on all new products for the Sinclair machines?

Sheree Draft
1171 Boylston St.
Boston, MA 02215

Ed.—We cannot review all new products; there are just too many. This is why we have invited reviews from users who have had extended experience with a given product and why we prefer comparative reviews whenever possible. We also expect such reviews to be honest and in-depth. The increase in space devoted to reviews will provide more extended product information.

Dear Editor:

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Robert J. McGarvey
28 Raleigh Rd.
Kendal Park, NJ 08824

Elimination

Dear Editor:

The Elimination Game in *SYNC* 2:5 can be used by unexpanded ZX81 users with a few changes. The original program uses a numeric array which requires over 50 bytes to store and a FOR-NEXT loop to print. The change uses strings to store the numbers (1 byte per character) instead of the array (5 bytes per character). Strings are ideal for storing numerical data from 0 to 9 because they are completely flexible in length and PRINT much faster.

The rules of the game are the same except that to terminate the game after a loss 0 is entered. Any other invalid number will begin the turnover from the roll. If more than one number is required to complete the roll, a total is given.

By the way, I am in the process of learning machine language, and, although I have a ZX81, I would like my machine code programs to run flicker-free on an 8K ZX80. Isn't there a subroutine in the ROM to display a frame to the TV?

Michael B. Williams
1300 DePaul Way
Virginia Beach, VA 23464

```
  10 RAND
  20 LET A$=" 1 2 3 4 5 6 7 8 9"
  30 LET R=INT (6*RND)+INT (6*RN
D)+2
  40 LET T=0
  50 LET B$=A$
  60 CLS
  70 PRINT "NUMBERS TO ELIMINATE
"
  80 PRINT AT 4,0;"ROLL ";R
  90 PRINT AT 2,0;B$;" "
 100 INPUT N
 110 IF NOT N THEN RUN
 120 IF ABS (N-5)>4 THEN GOTO 40
 130 IF B$(N+N)<>STR$ N OR NOT C
ODE B$(N+N) THEN GOTO 40
 140 LET T=T+N
 150 IF T>R THEN GOTO 40
 160 LET B$(N+N)=" "
 170 PRINT AT 4,11;"TOTAL ";T
 180 IF T<R THEN GOTO 90
 190 LET A$=B$
 200 IF A$<>"
THEN GOTO 30
 210 PRINT AT 0,0;"WINNER*******
********"
```

Elimination in 1K

Type in the program, hit RUN and ENTER.

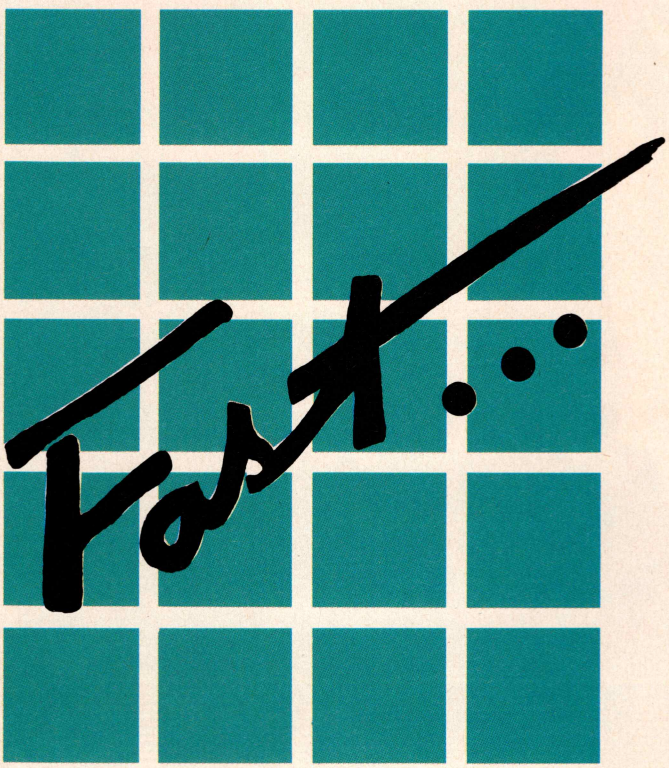
The numbers 1 to 9 will appear with a number representing a dice roll. Choose which number or numbers you wish to eliminate. Your choices must equal the number rolled. The object of the game is to eliminate all the numbers. When the end of the game is approaching, a roll higher than the total left in the display will end the game. The lowest number wins. To play again hit ENTER.

DEF and PAUSE

Dear Editor:

The article on DEF in *SYNC* 2:4 was very informative, especially for one using programs involving many repetitious mathematical expressions. However, the two programs used to demonstrate the use of A$ and F$(X) with VAL were too slow even in FAST. I would suggest a better program to illustrate the simulation of DEF FNA(X) on the ZX81.

Furthermore, if line 190 were written PRINT AT 23,10;F$(B), there would have been space on the bottom of the screen



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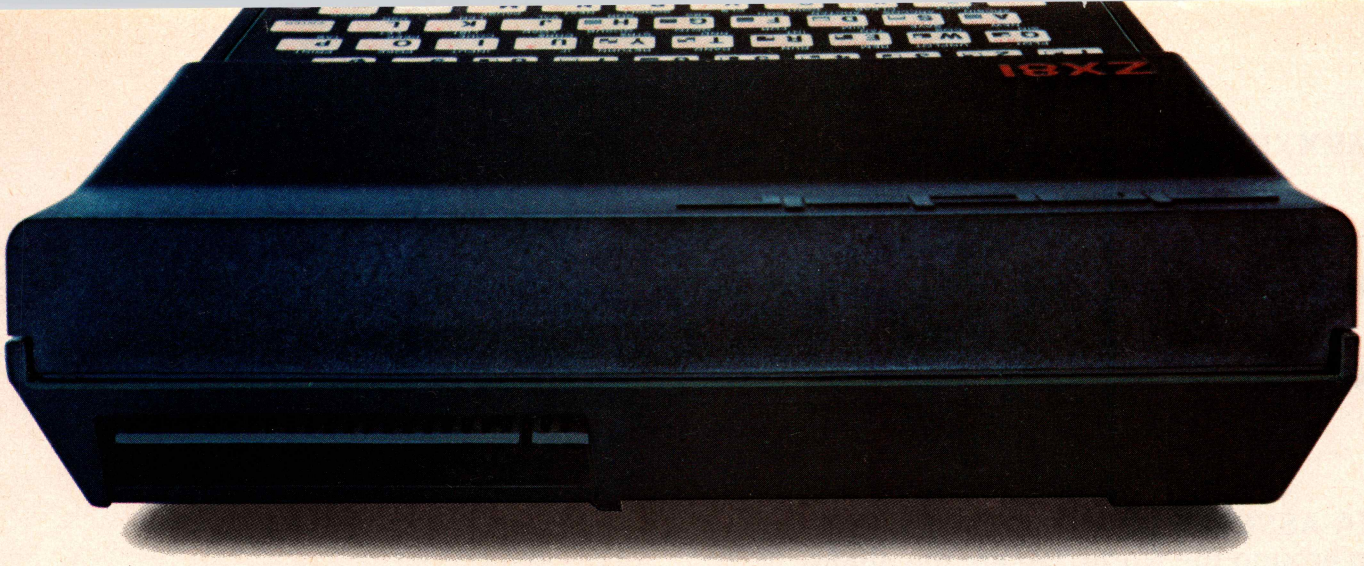

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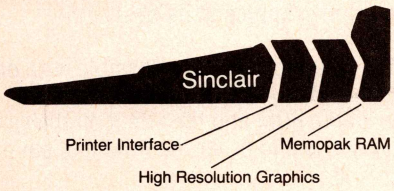

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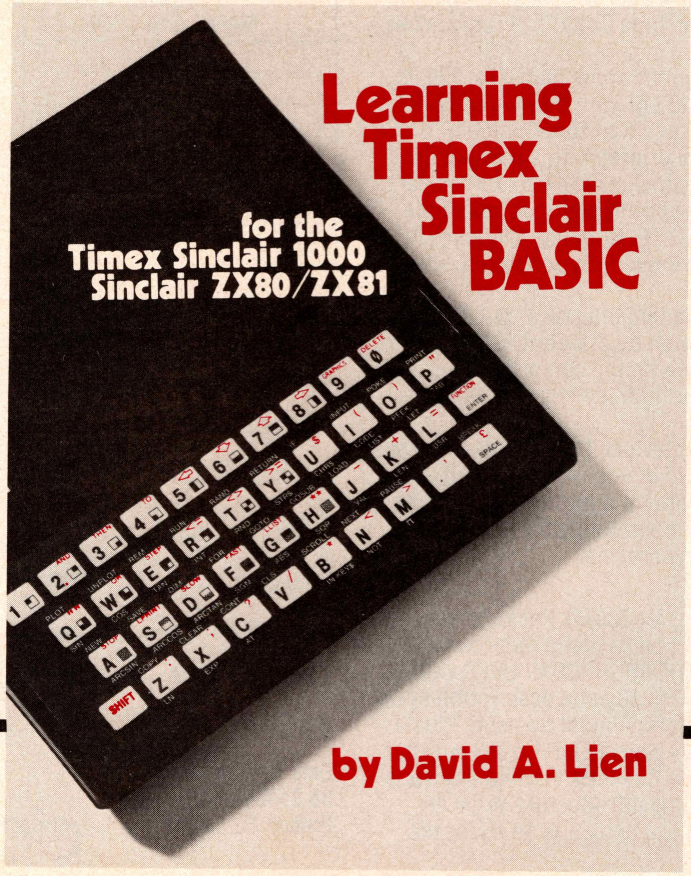

for a REPORT or CURSOR and the run could have been stopped any time by hitting BREAK as usual. Also, this would have eliminated the need for the fancy, and limited use of lines 330 to 370.

Alger Salt in *SYNC* 2:3 expains why he had to take extra steps to get around an idiosyncrasy in the Sinclair computer when the PAUSE function is used. I would suggest avoiding the use of PAUSE whenever possible and substituting a conventional FOR-NEXT loop instead. For example:

```
FOR N = 1 TO 50
NEXT N
```

PAUSE (at least on my TV screen) has another undesirable characteristic. It causes the image to jump. This is very disturbing in graphics. The do-nothing, FOR-NEXT loop does not impart any motion to the screen.

I use PAUSE mostly with, say PAUSE 40000, to get an indefinite delay in the run of a program. Then press any key except BREAK to continue. Another plus is the fact that the screen does not clear first when the program restarts.

Warren Fricke
273 Canton St.
Depew, NY 14043

try this

"Try This" features short programs to show off your computer, impress your family and friends, and tickle your imagination when *SYNC* arrives at your place. Send your contributions to: Try This, SYNC, 39 E. Hanover Ave., Morris Plains, NJ 07950.

4K ROM; 1K RAM

Enter the following lines:

```
10 PRINT 1;
20 POKE 16427,14
30 RUN
```

Press RUN and NEWLINE. Observe the results. When you see the error code, press any key except SHIFT, then press RUN and NEWLINE again. Can you figure out how this works? Our thanks to:

James Grosjean
50 Kings Rd.
Chatham, NJ 07928

8K ROM: 1K RAM

Enter the following lines:

```
10 PRINT ;;
20 GOTO 10
```

Put the computer in SLOW mode. Press RUN and ENTER. Observe the results. Can you figure out how this works? Our thanks to The Ultimate Magazine (reprinted with permission) and:

Neil Dewhurst
2 Chesterbrook, Ribchester
Nr. Preston PR3 3XT
United Kingdom

8K ROM; 1K RAM

Enter the following lines.

```
  5 FAST
 10 FOR A=0 TO 16 STEP .05
 20 LET R=8*COS (A)*COS (2*A)
 30 PLOT (13+(4*R*COS (A))),(22
+(4*R*SIN (A)))
 40 NEXT A
 50 PRINT AT 9,19;"■"
```

Press RUN and ENTER. Observe the results. Our thanks to:

Neal Neirick
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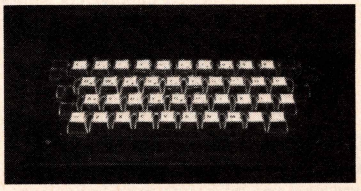
Des Plaines, IL 60016

PROFESSIONAL KEYBOARD

Timex Sinclair 1000 Sinclair ZX-81



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sync notes

Paul Grosjean

SYNC in the Home Office

Our theme section in this issue is "*SYNC* in the Home Office." Among the reasons for buying a computer is to get a tool that will take care of some of the drudgery of home record keeping and financial calculation. We have had a number of requests for such programs, so we have gathered several programs that illustrate something of how the Sinclair computer series can be used at home. In addition we have included several programs on time calculation, display set up, and making and maintaining support records.

This section is not an exhaustive presentation, and we hope to see more programs developed by our readers for home office work. Normally we do not accept programs showing how to use your computer as a calculator since we assume most people have calculators. This does not exclude programs which combine a series of time consuming steps on a calculator. In such cases the computer does what it is supposed to do, namely, compute.

Browsing through the ads and Resources Column of this issue and our last issue will show quite a variety of programs of possible use to the home office. If you have used one of these products and found it valuable, we hope you will write up a short review for us. Several reviews of products useful to the home office top off the theme emphasis of this issue.

We are planning a "SYNC on the Job" theme section for our Mar/Apr issue.

SYNC Buyer's Guide Issue

The May/June issue of *SYNC* will be a buyer's guide issue. We will have some regular articles, programs, and reviews, but the majority of the content will be a directory with short descriptions of all known peripherals, add-ons, software packages, books, and other products related to the Sinclair and Timex/Sinclair computers.

Vendors are invited to submit a product description of up to 60 words for each product they have available for this computer series. The description should include product name, order number, cost, ordering details, ROM and RAM requirements, and as complete a product description as possible within the 60 words. Send the descriptions to:

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SYNC Magazine
39 E. Hanover Ave.
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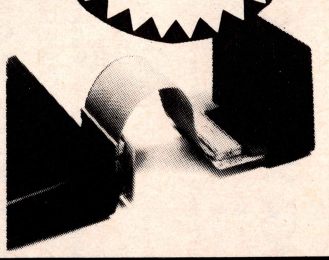
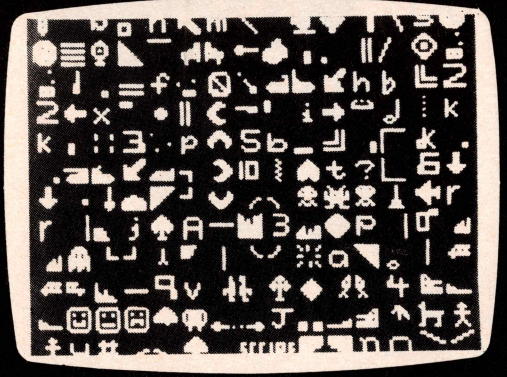
Cassette version **$12.50**
(D) Flexible ribbon connector (as illustrated) **$18**



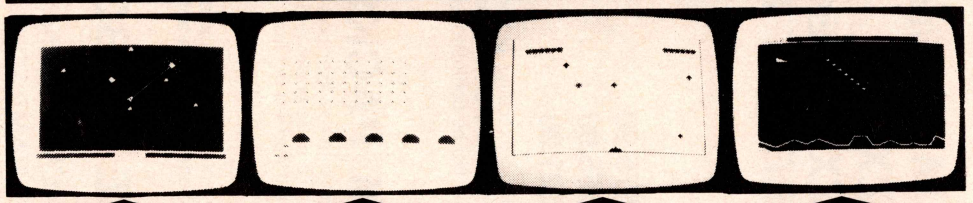
The DK Graphic module is our latest ZX81 accessory. This module, unlike most other accessories fits neatly inside your computer under the keyboard. The module comes ready built, fully tested and complete with a 4K graphic ROM. This will give you an unbelievable 448 extra pre-programmed graphics, your normal graphic set contains only 64. This means that you now have 512 graphics and with their inverse 1024. This now turns the 81 into a very powerful computer, with a graphic set rarely found on larger more expensive machines. In the ROM are lower case letters, bombs, bullets, rockets, tanks, a complete set of invaders graphics and that only accounts for about 50 of them, there are still about 400 left (that may give you an idea as to the scope of the new ROM). However, the module does not finish there; it also has a spare holder on the board which will accept a further 4K of ROM/RAM. This holder can be fitted with a 1K/2K/RAM and can be used for user definable graphics so you can create your own custom character sets.

$53.91

4K Graphics rom



SOME OF THE GRAPHICS NOW POSSIBLE ON THE ZX81



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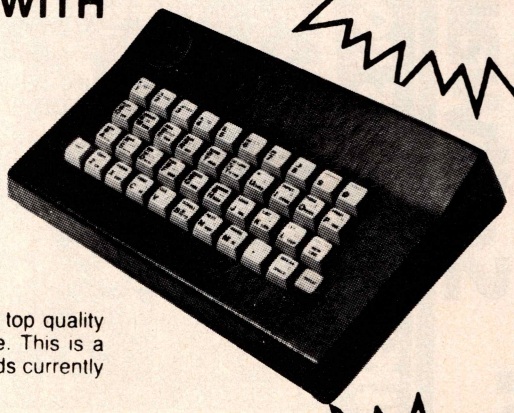

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The 16K RAMPACK simply plugs straight into the user port at the rear of your computer. It is fully compatible with all accessories and needs no extra power and therefore it will run quite happily on your Sinclair power supply. It does not over-heat and will not lose memory at all. As you may know, some makes go down to 11K after being on for a while.

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Machine Language Series

In this issue we are beginning a series of articles by Harry Doakes which will give newcomers to computing the benefits of machine language programming. Harry is no stranger to *SYNC* readers because of his articles "TR$ and LET A$=A$+B$ on the ZX80," "Safe Machine Code Routines," and "Maps and the ZX80/81." If you have specific areas of interest in machine language programming, drop us a line.

Sinclair Inquiries and Service

If you need hardware repairs, contact Sinclair's authorized service center:

MicroSync Services
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Keene, NH 03431

Inquiries concerning repairs (past, present, or future) should be mailed to MicroSync's Customer Service Department. Please send a stamped addressed envelope for additional service information. MicroSync is offering one year maintenance agreements for Sinclair and Timex/Sinclair computers. For further information contact MicroSync.

Sinclair Research Ltd. promises a prompt reply to customers with technical questions, product operating queries, or other problems. However, *only* mail inquiries can be answered. So write a letter indicating the details of your problem to:

Technical Department
Sinclair Research Ltd.
4 Sinclair Plaza
Nashua, NH 03061

SYNC on the Newsstands

You will be receiving this issue of *SYNC* somewhat earlier than you may have expected. The reason for this is that we have advanced the publication time about a month in order to enter into newsstand distribution of *SYNC*.

SYNC Program Listings

Before entering the programs in this issue, readers should note the following:

The **ROM** and **RAM** requirements for using a given program are shown at the top of the first page of the article. *Observe these carefully.* **NEWLINE** and **ENTER** are used interchangeably.

A letter after a number shows the type: b for binary; d for decimal; h for hexadecimal.

In PRINT statements:

#: Enter a necessary space.

A (32): Use the graphic character on the A key 32 times. The underline means use the graphic on that key.

A: The overline means use the key in inverse.

INPUT: An underlined *word* found on the keyboard should be entered from the keyboard, not spelled out. If the keyword will not ENTER, hit THEN, the keyword you want, backspace and delete THEN, continue entering the line. This memory saving technique may be disregarded if you have enough RAM.

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just for fun

Generally *SYNC* prefers articles in some depth to help you get more out of your computer. However, we receive many short programs that illustrate a point, demonstrate a technique, or show something the reader has found interesting. "Just for Fun" shares these programs with you. If you learn something, great. If you have some fun, great. If you have some that you want to share, send them to: Just for Fun, SYNC, 39 E. Hanover Ave., Morris Plains, NJ 07950.

Bombsmash

M. Hampson

In Bombsmash the display shown in the sample run passes over your firing base from right to left. Your base remains stationary. You fire at the moving targets by pressing any key. If you hit a part of the letters or inverse asterisks, you get one point. Your goal is to wipe out all the targets in the display. However, if your shot misses all of the targets and continues to the top edge of the display, you lose.

The program is entered in three steps:

1) Type in

1 REM (followed by 32 characters)

2) Type in as direct commands the POKEs in Listing 1.

3) Type in Listing 2.

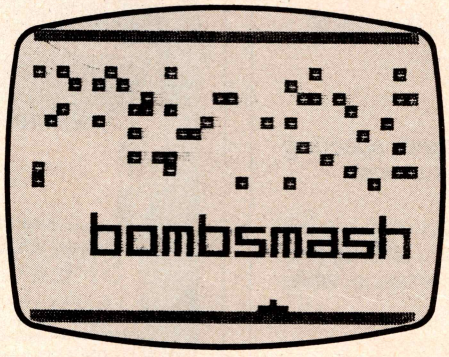
To play the game press RUN and ENTER. You fire by pressing any key. Your score will be displayed at the end of the game. The highest score is the best. Hit ENTER to start a new game.

Graphics notes:

20: A (32); set up display to show as in the listing; finish off with A(32).

31: inverse asterisk.

120: 6,W,4.



Listing 1.

```
POKE 16514,42
POKE 16515,12
POKE 16516,64
POKE 16517,6
POKE 16518,24
POKE 16519,197
POKE 16520,35
POKE 16521,126
POKE 16522,50
POKE 16523,33
POKE 16524,64
POKE 16525,84
POKE 16526,93
POKE 16527,35
POKE 16528,1
POKE 16529,31
POKE 16530,0
POKE 16531,237
POKE 16532,176
POKE 16533,43
POKE 16534,58
POKE 16535,33
POKE 16536,64
POKE 16537,119
POKE 16538,35
POKE 16539,193
POKE 16540,16
POKE 16541,233
POKE 16542,201
```

M. Hampson, 7 Hereford Dr., Clitheroe, Lancs BB7 1JP, U.K. Reprinted from *The Ultimate Magazine* with permission.

Listing 2.

```
 10 POKE 16418,0
 20 PRINT "                ";AT 15,5;"
bsmash bom                ";AT 23,0;"
                          "
 30 FOR Z=1 TO 50
 31 PRINT AT INT (RND*10)+3,INT
(RND*32);"■"
 32 NEXT Z
 40 LET B=0
 50 LET S=0
100 PRINT AT 22,15;"    "
110 RAND USR 16514
120 PRINT AT 22,15;"▬ "
130 IF NOT B THEN GOTO 200
135 LET P=P-1
140 PRINT AT P,15;
150 LET N=PEEK (PEEK 16398+256*
PEEK 16399)
155 PRINT "*"
160 IF N=6 THEN GOTO 300
170 IF N THEN GOTO 400
180 PRINT AT P,16;" "
190 GOTO 100
200 IF INKEY$="" THEN GOTO 100
210 LET P=22
220 LET B=1
230 GOTO 100
300 PRINT AT 1,1;"GAME OVER:YOU
R SCORE>>>>";S
310 IF INKEY$<>CHR$ 118 THEN GO
TO 310
320 CLS
330 RUN
400 LET S=S+1
410 LET B=0
420 GOTO 180
```

Space Pirate Attack

Sheldon Maloff

After a very successful mining operation in the asteroid belt, you are on the way back to your base to unload and resupply for the next expedition. Suddenly, you are attacked by a fleet of pirates. Although you are outnumbered 20 to 1, you have a chance because your position is such that they cannot attack

Sheldon Maloff, 1102-432 Huntsville Cr., N.W., Calgary, Alberta, Canada T2K 5E1.

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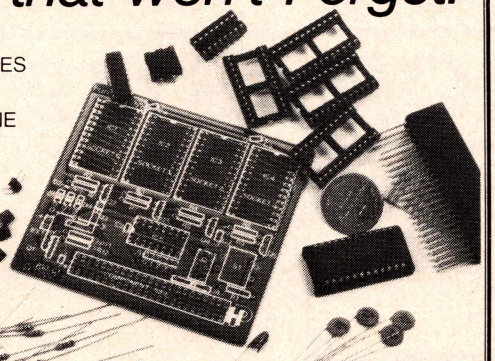

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you simultaneously. It all depends now on your skill and a little bit of luck. Your defense screen displays the field of attack. The radar will locate the pirate ship and show its location by displaying a number from 0 to 9. To fire you must press the corresponding key on your firing control console. If you are fast enough, you will score a hit. If you press the wrong key or do not fire at all, you will miss the pirate. In a fraction of a second the next pirate will appear on your screen. When all the twenty have appeared, the game ends and your score is displayed.

When you have entered the program, press RUN and ENTER. The playing grid consisting of colons will then appear on your screen. As soon as this grid is complete, the game starts. So be ready. A number from 0 to 9 will appear somewhere on the field. Press the same number on the keyboard to fire.

After the game is over, the field will be displayed. The periods represent the place where you destroyed a pirate ship. The pirates who escaped are shown by plus signs. The pirates that you were not fast enough to hit or that you did not shoot at are shown as numbers.

The computer randomly selects a time between 0.1 and 1.0 seconds when you press a firing button. The game thus combines the elements of skill and randomness that a good game must have.

Graphics notes:
5: PIRATES (inverse).
80: X (inverse).

```
  1 LET S=0
  5 PRINT AT 11,0;"PIRATES"
 10 FOR R=0 TO 9
 15 FOR C=0 TO 9
 20 PRINT AT R,C;":"
 25 NEXT C
 30 NEXT R
 35 FOR C=1 TO 20
 40 LET X=INT (RND*10)
 45 LET Y=INT (RND*10)
 50 PRINT AT X,Y;CHR$ (X+28)
 55 FOR R=1 TO 40*RND
 60 LET Q=CODE INKEY$-28
 65 IF Q<>-28 THEN LET R=100
 70 NEXT R
 75 IF Q<0 THEN GOTO 95
 80 PRINT AT Q,Y;"X"
 85 IF X=Q THEN LET S=S+1
 90 PRINT AT X,Y;"+";AT Q,Y;"."
 95 NEXT C
100 PRINT AT 10,0;"S=";S
```

Space Age Graphics

Robert G. Boyer

Keith Comer's article in *SYNC* 1:3 on graphics intrigued me, so I wanted to use it on my ZX80 with the 8K ROM. The conversion involved only a few changes in the program lines. However, the 4K and 8K ROMs have different codes for the characters. To convert a 4K ROM picture to the 8K ROM requires getting the character equivalents set up. The two lists are given in Table 1. If you are going to translate a picture, follow this table. However, you can start from scratch with your own ZX81 or T/S 1000.

To use the system, turn to "The Character Set" chapter in your manual. Put the letters A-J beside characters 1-10 and M-V beside characters 129-138. The inverse space becomes the letter L.

If you do not have the original article, get a sheet of graph paper. Lightly rule every other line horizontally and vertically so that you will have blocks divided into four smaller blocks. Each of the larger blocks represents a full character space on the computer. Now draw your picture by shading the small blocks. You can use solid black, grey, and white (by leaving a blank). When you are finished, look at the larger blocks and note which of the various pixel arrangements in the character set looks just like that four block unit. Enter the letter for that character into your string. Do not forget to indicate white spaces. The pound sign (found on the shifted space key) indicates the end of the line.

Robert G. Boyer, 1103 Rivlin Rd., Huntsville AL 35801.

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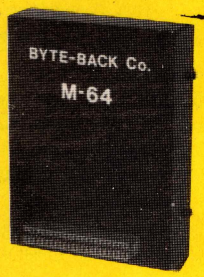

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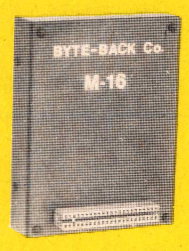

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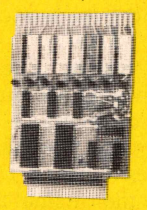

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You are converting your picture to a string which the computer will display as a picture using the graphics characters. With 16K RAM the possibilities for this program are endless.

Listing 1 gives the program for storing and producing your picture. A sample picture is given in line 10 in the A$ string. If you are developing your own picture, enter the letters into the A$ string in line 10. Type in the program, press RUN and ENTER. As you may guess when you see the picture, I work for NASA.

Figure 1. Character Sets.

4K ROM	8K ROM
2	5
3	131
4	1
5	2
6	4
7	135
8	6
9	8
10	9
11	11
130	133
131	3
132	129
133	130
134	132
135	7
136	134
137	136
139	138

Listing 1

```
 10 LET A$="3500£3BDIR£4BDIRD£5
MDIBR£405ROOOOOOOOCCOD£45A88BR£4
RO765OF£45RD8000CCCA£5AF55FC£5AF
55FC£6E3OCA£6CCCC£"
 20 LET X=CODE A$
 30 IF X=12 THEN PRINT
 40 IF X=12 THEN GOTO 60
 45 IF X<38 THEN GOTO 110
 50 IF X<48 THEN LET X=X-37
 55 IF X=48 THEN LET X=X+80
 60 IF X>47 THEN LET X=X+79
 70 PRINT CHR$ X;
 80 LET A$=A$(2 TO )
 90 IF A$="" THEN GOTO 145
100 GOTO 20
110 FOR N=1 TO X-26
120 PRINT " ";
130 NEXT N
140 GOTO 80
```

Driver

Neil Dewhurst

In Driver you are at the wheel of a race car on a hazardous race course. This is a test of your driving skills. You must avoid the obstacles as you speed toward to finish line. The car heads left by itself. Pressing any key makes it head the other way. Your score is displayed when you crash. Pressing any key restarts the game.

This program uses the graphics capabilities of the ZX81 to create the screen display of a road and the obstacles along the way. The SCROLL feature produces a moving course. The INKEY$ function allows the input of any key for control.

Graphics notes:

40: G

70: H

To make the game more difficult, change line 40 as indicated at the end of the listing.

```
 10 LET P=16
 20 LET S=0
 30 SCROLL
 40 PRINT "■";TAB INT (RND*19)+
1;"■";TAB 20;"■"
 50 PRINT AT 10,P;
 60 IF 137=PEEK (PEEK 16398+256
*PEEK 16399) THEN GOTO 100
 70 PRINT "■"
 80 LET S=S+1
 90 LET P=P+1-(INKEY$="")*2
 99 GOTO 30
100 PRINT S
110 PAUSE 4E4
120 GOTO 20
```

```
 40 PRINT "■";TAB INT (RND*12)+
1;"■          ■";TAB 20;"■"
```

Neil Dewhurst, 2 Chesterbrook, Ribchester, Nr. Preston, PR3 3XT, U.K. Reprinted from *The Ultimate Magazine* with permission.

ZX81 · TS1000

SOFTWARE

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Includes: "Jargon" - a jargon word generator. "Animal" - a fun game where the player teaches the computer all about animals. "Story" - the computer writes stories using the players input names, places, etc. Can be very funny for kids. "Haiku" - the computer composes HAIKU like poetry. Requires 16K. $10.95

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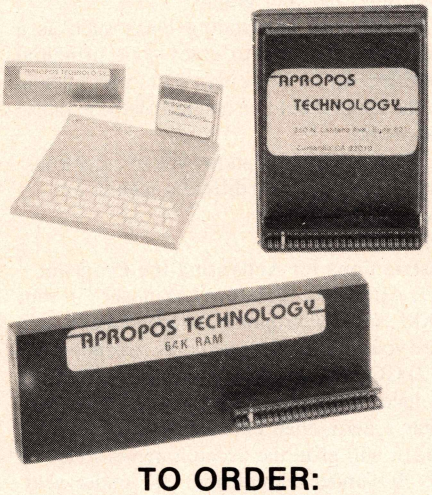

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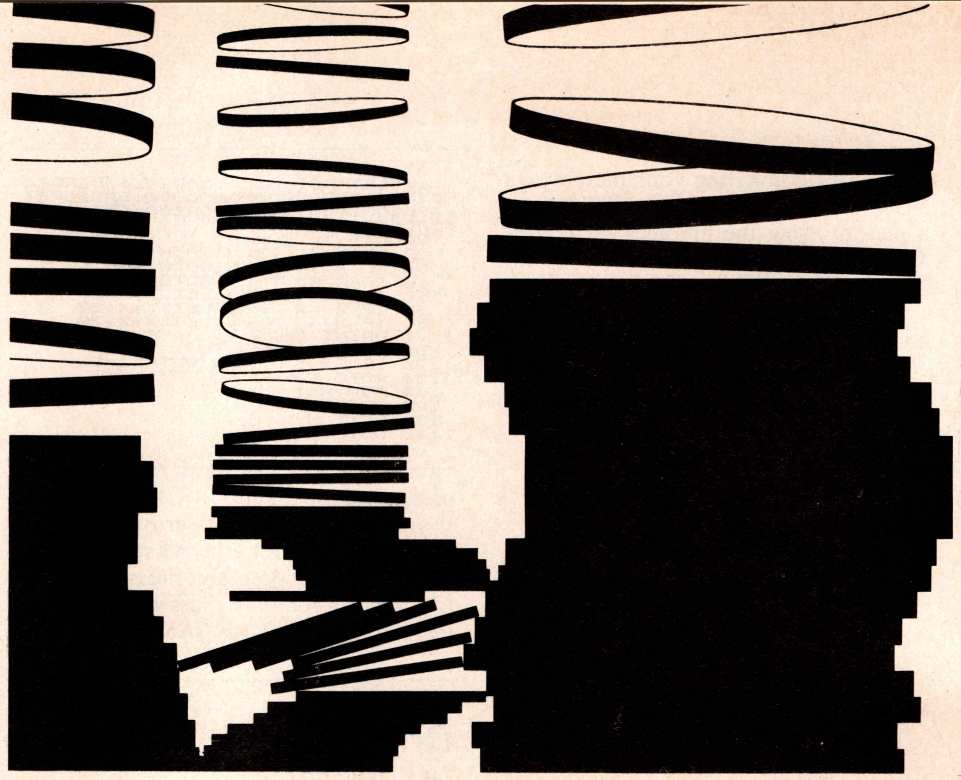
Alan Pattison



Where do we stand financially? This is one of the questions of greatest concern in the home office. We make our deposits, write our checks, and pay our bills, but these activities do not provide the information we need to interpret our position. We need to know not only our income and outgo, but also where our money is and what it is doing. We need to know not only this year, but also last year and other years. The program below is one that I developed to provide answers to such questions for my own situation. You may not have the same needs or questions, but perhaps the program will enable you to pose the questions you want to your computer and find the answers you need.

When the program has been activated, simply enter income, expense, and loan principal items each month. The computer will then provide you with:

1) An income statement for the current month and the year-to-date.
2) An expense statement for the current month and the year-to-date.
3) A balance sheet showing your various assets, liabilities, and net worth.
4) A cash flow statement for the month and the year-to-date.
5) A comparison of expenses to date with your yearly budget.
6) A month by month graph comparing income with expenses.
7) Another month by month graph comparing each month's expenses this year with those of last year.
8) A listing showing month by month income and expenses as well as your average monthly income and expenses.

You can make as many entries as necessary for any item—right out of your check book, Visa or Master Charge records, etc. Your checking account balance and all other assets and liabilities will appear correctly on your balance sheet. There is also a provision for entering transfers of funds between accounts.

The program works best with your computer in FAST mode.

To use the program, each month simply enter your income and expenses—typing in the name of the item and the amount of the transaction. The computer will ask which account the money is for or from, which you enter by code "X," "S," etc.

The computer will add together similar items and adjust your assets and liabilities page, your income and expense totals, your cash flow, and your graphs.

If you have outstanding loans such as a mortgage, be sure to enter your principal payments under menu item #10. Your interest on the loans should be entered on the expense statement.

The program also allows you to enter transfers of funds between different accounts under menu item #10.

Instructions for Activating the Program

1) After loading "Money Manager" in your ZX81, save the program on tape just as it is in case you mess up the rest of the instructions.

2) GOTO 5 and enter menu item #1. Enter an income account name, e.g. "SALARY," enter a zero, then enter another zero. Your screen will print the account name, followed by "0" under Month and "0" under year. Continue entering account names, followed by the two zeros until you have entered six. (Note: If you want more or less than six categories, change the DIM statements in this section as well as the FOR/NEXT loops).

3) Enter "2" and return to menu. Press "2" and you will be on the expense sheet. Here, you must type in each expense account name, followed by "0," "0," just as you did with income. The program is set up for 17 expense items, so, if you want more or less, you will need to change the DIM statements and FOR/NEXT loops in this expense section. With 17 expense items, your screen will display a Code 5 at the bottom—press "C" and ENTER to continue.

4) Enter "2" and return to menu. Exit the program by entering menu item 12.

5) Delete all the following statements in your listing (simply type each number and ENTER, one by one.)
235, 236, 238, 239, 241, 242, 255, 260, 265, 519, 522, 523, 524, 525, 526, 527, 528, 531, 532, 533.

6) Type GOTO 1700 and ENTER. Your screen will show a report code 2. Now type GOTO 2500 and ENTER. Your graph format will appear on the screen.

7) Type GOTO 3600 and ENTER. Again your screen will show a report code 2. Type GOTO 4500 and ENTER. Your income/expense graph format will appear on the screen.

8) Delete the following statements in your listing by typing and ENTERing each number individually.
1700, 1720, 1740, 3600, 3610, 3620.

9) For the 2-Year expense comparison graph, you must enter each of last year's monthly expenses. (If you do not do this, this graph should be ignored.) Type in the following:

LET R(1)=(January last year expenses)
LET R(3)=(February last year expenses)
LET R(5)=(March last year expenses)

Continue with LET R statements 7, 9, 11, 13, 15, 17, 19, 21, 23 for the remaining months of last year. (Note that these are all odd numbers—even numbers are reserved for the current year.)

Last year's expense entries will be held in reserve and will not appear on the graph until the corresponding months this year are entered. (Except, the graph will show each succeeding month's expenses for last year as well as those through the current months.)

Alan Pattison, 3422 French Loop NW, Olympia, WA 98502.

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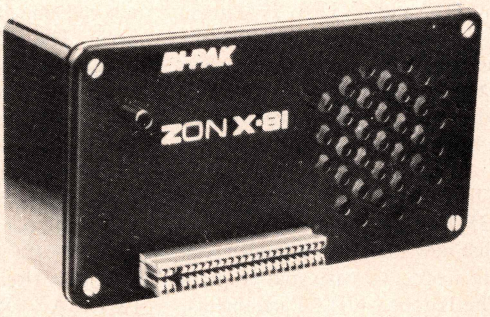

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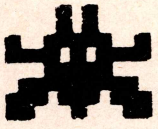

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10) Type GOTO 5 and ENTER. Type menu item #8 and your budget page will be on the screen. As each budget expense item appears, type in and ENTER your budgeted amount for that item. When the screen shows a report code 5 at the bottom, press "C" for the next page.

11) Delete listing statements 3100, 3105, 3120, and 3135.

12) You must now load the computer with additional data in order to make your program work right. This is done with LET statements, entered one by one (numbering not necessary). The titles may be changed to fit your own situation. Type in as follows:

a) Load your Assets:

LET X=(Checking account balance)
LET V=(Visa or other cash card balance)
LET S=(Savings account)
LET C=(Cash on hand)
LET CD=(Certificates of deposit)
LET ST=(Stocks and bonds)
LET PR=(Real and personal property)
LET MA=(Other assets)

b) Load your Liabilities:

LET MG=(Mortgage principal balance)
LET L=(Other loan balance)

13) Type GOTO 5 and ENTER. Your program is now set up for you to use. If you are starting the program in the middle of the year, enter income and expense items month by month for all prior months. This is important if your graphs are to work correctly. If you do make entries for prior months, your balance sheet will no longer be correct. Therefore you should go back to instruction #12 and reload your Assets and Liabilities.

Listing 1.

```
   2 REM ******** DESIGNED BY
ALAN PATTISON, OLYMPIA, WA
   5 REM "MONEY MANAGER"
   6 REM MA=MISC. ASSETS,X=CHECK
ING,V=VISA,S=SAVINGS,C=CASH,CD=C
ERT. OF DEP.,ST=STOCKS,MG=MORTGA
GE,L=INS.LOAN
   7 LET S$="
"
   8 CLS
   9 SLOW
  10 PRINT
  11 LET T$="
"
  12 PRINT S$
  15 PRINT TAB 9;"MONEY MANAGER"
  18 PRINT T$
  20 PRINT
  22 LET F$="--------------------
----------"
  25 PRINT "DO YOU WANT TO:"
  28 PRINT
  30 PRINT TAB 1;"1)CHECK INCOME
 STATEMENT?"
  35 PRINT TAB 1;"2)CHECK EXPENS
E STATEMENT?"
  40 PRINT TAB 1;"3)CHECK ASSETS
 AND LIABILITIES?"
  45 PRINT TAB 1;"4)ENTER INCOME
 ITEMS?"
  50 PRINT TAB 1;"5)ENTER EXPENS
E ITEMS?"
  55 PRINT TAB 1;"6)SEE INCOME/E
XPENSE GRAPH?"
  58 PRINT TAB 1;"7)SEE 2-YEAR E
XPENSES GRAPH?"
  59 PRINT TAB 1;"8)COMPARE EXPE
NSES WITH BUDGET?"
  60 PRINT TAB 1;"9)SEE CASH FLO
W STATEMENT?"
  61 PRINT "10)TRANSFER FUNDS; R
EPAY LOANS?"
  62 PRINT "11)SEE MONTHLY INCOM
E/EXPENSE?"
  63 PRINT "12)EXIT PROGRAM?"
  64 PRINT
  65 PRINT "ENTER YOUR CHOICE, 1
 TO 12."
  70 INPUT O
  75 CLS
  80 IF O=1 THEN GOTO 200
  85 IF O=2 THEN GOTO 500
  90 IF O=3 THEN GOTO 800
  95 IF O=4 THEN GOTO 300
 100 IF O=5 THEN GOTO 580
 105 IF O=6 THEN GOTO 4000
 110 IF O=7 THEN GOTO 2000
 115 IF O=8 THEN GOTO 3000
 118 IF O=9 THEN GOTO 6000
 119 IF O=10 THEN GOTO 6500
 120 IF O=11 THEN GOTO 7500
 121 IF O=12 THEN GOTO 1000
 200 REM *INCOME STATEMENT*
 210 REM AFTER ENTERING CATEGORI
ES, DELETE 235,236,238,239,241,2
42,255,260,265
 223 PRINT TAB 12;"
"
 225 PRINT TAB 12;"  INCOME  "
 230 PRINT TAB 12;"
"
 232 PRINT T$
 235 DIM L$(6,15)
 236 DIM H(6)
 238 DIM F(6)
 239 LET M$="MONTH"
 240 PRINT "ITEM";TAB 16;M$;TAB
25;"YEAR"
 241 LET HT=0
 242 LET FT=0
 245 PRINT S$
 250 FOR B=1 TO 6
 255 INPUT L$(B)
 260 INPUT H(B)
 265 INPUT F(B)
 270 PRINT L$(B);TAB 16;H(B);TAB
24;F(B)
 280 NEXT B
 285 PRINT F$
 290 PRINT "TOTAL";TAB 16;HT;TAB
24;FT
 291 PRINT T$
 292 PRINT "TYPE ""1"" TO MAKE E
NTRIES,"
 293 PRINT """2"" TO RETURN TO S
TART."
 294 INPUT W
 295 CLS
 296 IF W=2 THEN GOTO 5
 299 REM *INCOME ENTRIES*
 310 PRINT "IS THIS A NEW MONTH?
"
 320 INPUT K$
 330 IF K$="NO" THEN GOTO 374
 340 FOR Z=1 TO 6 STEP 1
 350 LET HT=0
 360 LET B=Z
 365 LET H(Z)=0
 370 NEXT Z
 372 PRINT "TYPE MONTH-3 LETTER
ABBREVIATION"
 373 INPUT M$
 374 CLS
 375 PRINT TAB 8;"INCOME ENTRIES
"
 376 PRINT S$
 380 PRINT "TO END ENTRIES TYPE
 ""RETURN"" ."
 390 PRINT T$
 395 PRINT TAB 16;M$;TAB 25;"YEA
R"
 396 PRINT S$
 400 PRINT "ITEM:"
 410 INPUT P$
 415 IF P$="RETURN" THEN GOTO 5
 420 LET A=LEN P$
 425 DIM R$(6,A)
 430 FOR B=1 TO 6
 435 LET R$(B)=L$(B)
 440 IF P$=R$(B) THEN GOTO 452
 442 NEXT B
 444 PRINT
 446 PRINT "NO SUCH CATEGORY--TY
PE AGAIN."
 448 PRINT
 450 GOTO 400
 452 PRINT L$(B);TAB 16;H(B);TAB
24;F(B)
 454 PRINT "AMT.: ";
 456 INPUT E
 458 PRINT "$";E
 460 PRINT "FOR ACCT.: ";
 461 INPUT U$
 462 PRINT U$
 464 IF U$="X" THEN LET X=X+E
 466 IF U$="S" THEN LET S=S+E
 468 IF U$="V" THEN LET V=V+E
 470 IF U$="C" THEN LET C=C+E
 472 IF U$="CD" THEN LET CD=CD+E
 474 IF U$="ST" THEN LET ST=ST+E
 475 IF U$="MA" THEN LET MA=MA+E
 476 LET H(B)=H(B)+E
 478 LET HT=HT+E
 480 LET F(B)=F(B)+E
 482 LET FT=FT+E
 483 PRINT F$
 484 PRINT "TO DATE";TAB 16;H(B)
;TAB 24;F(B)
 485 PRINT F$
 486 PRINT "TOTAL INCOME";TAB 16
;HT;TAB 24;FT
 488 PRINT S$
 490 GOTO 400
 500 REM *EXPENSE STATEMENT*
 505 REM AFTER ENTERING EXPENSE
CATEGORIES, DELETE 519,522,523,5
24,525,526,527,528,531,532,533
 512 PRINT TAB 11;"
"
 515 PRINT TAB 11;"  EXPENSES  "
 517 PRINT TAB 11;"
"
 518 PRINT T$
 519 LET D$="MONTH"
 520 PRINT "ITEM";TAB 16;D$;TAB
25;"YEAR"
 522 DIM I$(17,15)
 523 DIM M(17)
 524 DIM T(17)
 525 LET MT=0
 526 LET TT=0
 527 LET PPT=0
 528 LET PPX=0
 529 PRINT S$
 530 FOR N=1 TO 17
 531 INPUT I$(N)
 532 INPUT M(N)
 533 INPUT T(N)
 535 PRINT I$(N);TAB 16;M(N);TAB
 24;T(N)
 540 NEXT N
 550 PRINT F$
 560 PRINT "TOTAL";TAB 16;MT;TAB
 24;TT
 565 PRINT T$
 570 PRINT "TYPE ""1"" TO MAKE E
NTRIES, ""2"" TORETURN TO START.
"
 572 INPUT W
 575 IF W<>1 THEN GOTO 5
 576 REM *EXPENSE ENTRIES*
 580 PRINT
 581 PRINT "IS THIS A NEW MONTH?
"
 582 INPUT Y$
 583 IF Y$="NO" THEN GOTO 599
 584 IF Y$="YES" THEN LET PPT=0
 585 PRINT "TYPE MONTH-3 LETTER
ABBREVIATION"
 586 INPUT D$
 590 FOR D=1 TO 17 STEP 1
 592 LET MT=0
 594 LET N=D
 596 LET M(D)=0
 598 NEXT D
 599 CLS
 600 PRINT TAB 8;"EXPENSE ENTRIE
S"
 601 PRINT S$
 602 PRINT "TO END ENTRIES TYPE
 ""RETURN"" ."
 603 PRINT T$
 605 PRINT TAB 15;D$;TAB 25;"YEA
R"
 607 PRINT S$
 608 PRINT "ITEM:"
```

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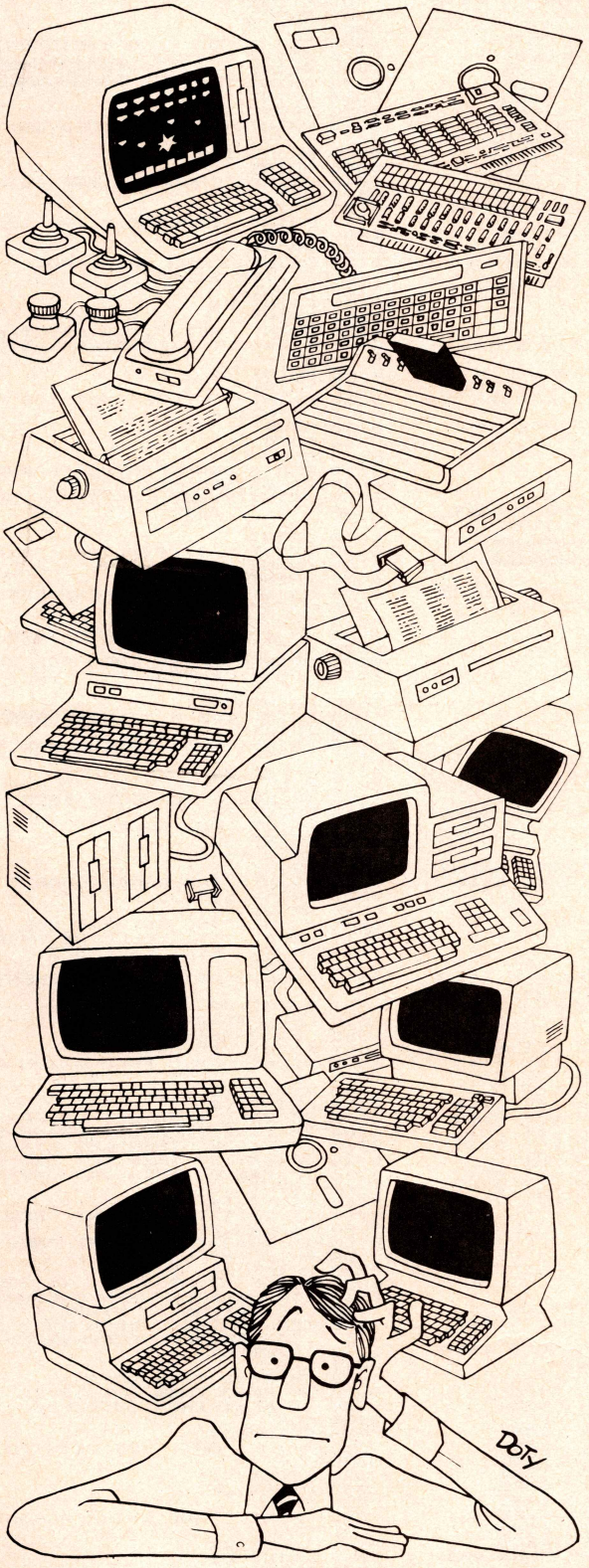

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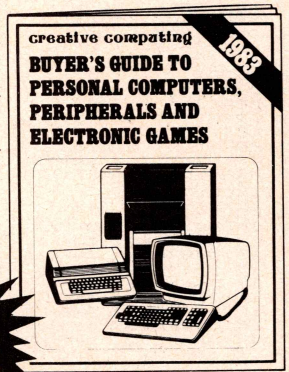

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```
  610 INPUT C$
  615 IF C$="RETURN" THEN GOTO 5
  620 LET J=LEN C$
  630 DIM X$(17,J)
  640 FOR N=1 TO 17
  650 LET X$(N)=I$(N)
  660 IF C$=X$(N) THEN GOTO 700
  670 NEXT N
  680 PRINT "NO SUCH CATEGORY--TY
PE AGAIN."
  695 GOTO 605
  700 PRINT I$(N);TAB 16;M(N);TAB
 24;T(N)
  705 PRINT "AMT.: ";
  708 INPUT K
  710 PRINT "$";K
  715 PRINT "FROM ACCT.: ";
  716 INPUT Q$
  720 PRINT Q$
  722 IF Q$="X" THEN LET X=X-K
  724 IF Q$="S" THEN LET S=S-K
  725 IF Q$="V" THEN LET V=V-K
  727 IF Q$="C" THEN LET C=C-K
  730 LET M(N)=M(N)+K
  735 LET MT=MT+K
  740 LET T(N)=T(N)+K
  742 LET TT=TT+K
  743 PRINT F$
  745 PRINT "TO DATE";TAB 16;M(N)
;TAB 24;T(N)
  746 PRINT F$
  748 PRINT "TOTAL EXPENSE";TAB 1
6;MT;TAB 24;TT
  749 PRINT S$
  750 GOTO 605
  800 REM *ASSETS/LIABILITIES*
  810 REM THESE ARE INITIALLY ENT
ERED WITH LET STATEMENTS.
  826 PRINT TAB 4;"
"
  827 PRINT TAB 4;"  ASSETS AND LI
ABILITIES  "
  828 PRINT TAB 4;"
"
  830 PRINT
  832 PRINT S$
  840 PRINT TAB 3;"CHECKING BAL."
;TAB 20;X
  845 PRINT TAB 3;"VISA BAL.";TAB
 20;V
  850 PRINT TAB 3;"SAVINGS BAL.";
TAB 20;S
  855 PRINT TAB 3;"CASH BAL.";TAB
 20;C
  860 PRINT TAB 3;"CERTS. OF DEP.
";TAB 20;CD
  865 PRINT TAB 3;"STOCKS";TAB 20
;ST
  870 PRINT TAB 3;"MISC. ASSETS";
TAB 20;MA
  872 PRINT TAB 3;"PROPERTY";TAB
 20;PR
  875 PRINT TAB 3;"  ASSETS";TAB
 20;X+V+S+C+CD+ST+MA+PR
  880 PRINT S$
  885 PRINT TAB 3;"MORTGAGE";TAB
 20;MG
  890 PRINT TAB 3;"INS. LOAN";TAB
 20;L
  893 PRINT TAB 3;"  LIABILITIES"
  TAB 20;MG+L
  894 PRINT S$
  895 PRINT TAB 3;"  NET WORTH";T
AB 20;(X+V+S+C+CD+ST+MA+PR)-(MG+
L)
  898 PRINT S$
  900 PRINT "ENTER ""C"" TO RETUR
N TO START."
  910 STOP
  920 GOTO 5
  990 REM *EXIT PROGRAM INCLUDING
  SAVE*
1000 PRINT "YOU HAVE INDICATED Y
OU WISH TO  EXIT THIS PROGRAM."
1005 PRINT
1010 PRINT "IF YOU HAVE MADE ANY
 CHANGES"
1015 PRINT
1020 PRINT "
"
1025 PRINT "  DO NOT FORGET TO RE
-LOAD TAPE  "
1030 PRINT "
"
1040 PRINT
1050 PRINT "TO SAVE THIS PROGRAM
 AS CHANGED  PREPARE THE TAPE REC
ORDER, BEGINRECORDING, AND TYPE
""G"" ."
1060 STOP
1070 SAVE "MONEY MANAGE"
1080 GOTO 5
1090 STOP
1690 REM *2-YR EXPENSE GRAPH*
1695 REM AFTER RUNNING 1700, DEL
ETE 1700,1720,1740
1696 REM LAST YEARS MONTHLY EXPE
NSES ARE ENTERED WITH LET STATEM
ENTS-R(1) TO R(23)(EVERY ALTERNA
TE NUMBER)
1700 DIM R(24)
1720 FOR I=1 TO 20
1740 PRINT I;"   ";
2000 CLS
2001 PRINT AT 8,0;5$
2002 PRINT "IT WILL TAKE A COUPL
E OF MINUTESTO PREPARE GRAPH...T
AKE A BREAK."
2003 PRINT T$
2004 PAUSE 200
2005 IF D$="JAN" THEN LET G=2
2010 IF D$="FEB" THEN LET G=4
2015 IF D$="MAR" THEN LET G=6
2020 IF D$="APR" THEN LET G=8
2025 IF D$="MAY" THEN LET G=10
2030 IF D$="JUN" THEN LET G=12
2035 IF D$="JUL" THEN LET G=14
2040 IF D$="AUG" THEN LET G=16
2045 IF D$="SEP" THEN LET G=18
2050 IF D$="OCT" THEN LET G=20
2055 IF D$="NOV" THEN LET G=22
2060 IF D$="DEC" THEN LET G=24
2065 FAST
2070 LET Q=MT
2080 LET R(G)=Q
2500 CLS
2510 FOR I=15 TO 0 STEP -1
2520 PRINT AT ABS I-15,I<5;I*2;
2530 FOR U=1 TO 24
2540 IF NOT R(U) THEN GOTO 2600
2550 LET Y=R(U)+-I*200
2560 IF Y<-25 THEN PRINT " ";
2561 IF U=1 THEN GOTO 2585
2562 IF U=3 THEN GOTO 2585
2563 IF U=5 THEN GOTO 2585
2564 IF U=7 THEN GOTO 2585
2565 IF U=9 THEN GOTO 2585
2566 IF U=11 THEN GOTO 2585
2567 IF U=13 THEN GOTO 2585
2568 IF U=15 THEN GOTO 2585
2569 IF U=17 THEN GOTO 2585
2570 IF U=19 THEN GOTO 2585
2571 IF U=21 THEN GOTO 2585
2572 IF U=23 THEN GOTO 2585
2575 IF Y>-26 AND Y<25 THEN PRI
T "■";
2580 IF Y>24 THEN PRINT "■";
2582 NEXT U
2585 IF Y>-26 AND Y<25 THEN PRI
T "▒";
2588 IF Y>24 THEN PRINT "▒";
2590 NEXT U
2600 PRINT
2610 NEXT I
2620 PRINT AT 16,0;"81J F M A M
 J J A S O N D"
2630 PRINT AT 17,0;"82 J F M A M
 J J A S O N D"
2635 PRINT AT 19,7;"EXPENSE  19
1-1982"
2638 PRINT AT 21,6;"(TYPE ""C""
TO RETURN)"
2640 STOP
2650 GOTO 5
3000 CLS
3005 REM *BUDGET*
3006 REM AFTER ENTERING BUDGET,
DELETE 3100,3105,3120,3135
3010 PRINT TAB 12;"
3015 PRINT TAB 12;"  BUDGET  "
3020 PRINT TAB 12;"
3025 PRINT T$
3030 PRINT "EXPENSES";TAB 16;"TO
 DATE";TAB 25;"BUDGET"
3040 PRINT S$
3100 DIM P(17)
3105 LET BT=0
3110 FOR N=1 TO 17
3115 PRINT I$(N);TAB 16;T(N);
3120 INPUT P(N)
3130 PRINT TAB 25;P(N)
3135 LET BT=BT+P(N)
3140 NEXT N
3160 PRINT F$
3170 PRINT "TOTALS";TAB 16;TT;TA
B 25;BT
3175 PRINT T$
3176 PRINT
3180 PRINT "ENTER ""C"" TO RETUR
N TO START."
3185 STOP
3190 GOTO 5
3500 REM *INCOME/EXPENSE GRAPH*
3590 REM DELETE 3600,3610,3620 A
FTER RUNNING 3600
3600 DIM U(24)
3610 FOR I=1 TO 20
3620 PRINT I;"   ";
4000 CLS
4001 PRINT AT 8,0;5$
4002 PRINT "IT WILL TAKE A MINUT
E OR TWO TO PREPARE GRAPH.....S
O HAVE A CUPOF COFFEE."
4003 PRINT T$
4004 PAUSE 200
4005 IF M$="JAN" THEN LET D=2
4010 IF M$="FEB" THEN LET D=4
4015 IF M$="MAR" THEN LET D=6
4020 IF M$="APR" THEN LET D=8
4030 IF M$="MAY" THEN LET D=10
4035 IF M$="JUN" THEN LET D=12
4040 IF M$="JUL" THEN LET D=14
4045 IF M$="AUG" THEN LET D=16
4050 IF M$="SEP" THEN LET D=18
4055 IF M$="OCT" THEN LET D=20
4060 IF M$="NOV" THEN LET D=22
4062 IF M$="DEC" THEN LET D=24
4063 FAST
4065 LET Q=MT
4068 LET Z=MT
4070 LET U(D-1)=Z
4075 GOSUB 4500
4080 LET U(D)=Q
4500 CLS
4510 FOR I=15 TO 0 STEP -1
4520 PRINT AT ABS I-15,I<5;I*2;
4530 FOR U=1 TO 24
4540 IF NOT U(U) THEN GOTO 4600
4550 LET Y=U(U)+-I*200
4560 IF Y<-25 THEN PRINT " ";
4561 IF U=1 THEN GOTO 4585
4562 IF U=3 THEN GOTO 4585
4563 IF U=5 THEN GOTO 4585
4564 IF U=7 THEN GOTO 4585
4565 IF U=9 THEN GOTO 4585
4566 IF U=11 THEN GOTO 4585
4567 IF U=13 THEN GOTO 4585
4568 IF U=15 THEN GOTO 4585
4569 IF U=17 THEN GOTO 4585
4570 IF U=19 THEN GOTO 4585
4571 IF U=21 THEN GOTO 4585
4572 IF U=23 THEN GOTO 4585
4575 IF Y>-26 AND Y<25 THEN PRIN
T "■";
4580 IF Y>24 THEN PRINT "■";
4582 NEXT U
4585 IF Y>-26 AND Y<25 THEN PRIN
T "▒";
4588 IF Y>24 THEN PRINT "▒";
4590 NEXT U
4600 PRINT
4610 NEXT I
5020 PRINT AT 16,2,"IEIEIEIEIEIE
IEIEIEIEIEIE"
5030 PRINT AT 17,2;" J F M A M J
 J A S O N D"
5040 PRINT AT 19,5;"INCOME AND E
XPENSE 1982"
5050 PRINT AT 21,6;"(TYPE ""G5""
 TO RETURN)"
5100 RETURN
6000 CLS
6005 REM *CASH FLOW STATEMENT*
6010 PRINT TAB 10;"
6020 PRINT TAB 10;"  CASH FLOW  "
6030 PRINT TAB 10;"
6040 PRINT
6050 PRINT T$
6070 PRINT TAB 16;M$;TAB 25;"YEA
R"
6080 PRINT S$
6085 PRINT
6090 PRINT "INCOME:";TAB 16;MT;T
AB 24;FT
6100 PRINT
6110 PRINT "EXPENSE:";TAB 16;MT;
TAB 24;TT
6120 PRINT
6122 PRINT "LOAN PRIN. PD.:";TAB
 16;PPT;TAB 24;PPX
6125 PRINT
6130 PRINT F$
6140 PRINT
6150 PRINT "NET:";TAB 16;MT-MT-P
PT;TAB 24;INT ((FT-TT-PPX)*100+.
5)/100
6160 PRINT T$
6170 PRINT
6180 PRINT "  TYPE ""C"" TO RETU
RN TO START."
6190 STOP
6200 GOTO 5
6500 CLS
6510 REM *LOAN REPAYMENTS AND TR
ANSFERS BETWEEN ACCOUNTS*
6550 PRINT "WHICH CATEGORY DO YO
U WANT?     ENTER ""1"" OR ""2""
."
6560 PRINT
6570 PRINT "  1)PRINCIPAL PAYMENT
S ON LOANS"
6575 PRINT
6580 PRINT "  2)TRANSFERS BETWEEN
 ACCOUNTS"
6590 INPUT CA
6600 IF CA<>1 THEN GOTO 7000
6602 CLS
6605 PRINT "WHICH LOAN ARE YOU P
AYING ON?   ENTER ""1"" OR ""2""
."
6606 PRINT
6608 PRINT TAB 5;"1)MORTGAGE"
6609 PRINT
6610 PRINT TAB 5;"2)INSURANCE LO
AN"
6612 INPUT Z0
6615 CLS
6618 IF Z0=2 THEN GOTO 6625
6619 PRINT T$
6620 PRINT "MORTGAGE:"
6621 PRINT S$
6622 GOTO 6630
6625 PRINT T$
6626 PRINT "INSURANCE LOAN:"
6627 PRINT S$
6630 PRINT
6631 PRINT "(DO NOT INCLUDE INTE
REST HERE - IT SHOULD BE ENTERED
 WITH CUR-  RENT EXPENSES."
6635 PRINT
6640 PRINT "PRINCIPAL PAYMENT =
";
6650 INPUT PP
6655 LET PPT=PPT+PP
6656 LET PPX=PPX+PP
6660 PRINT "$";PP
6670 PRINT "PAID FROM WHICH ACCO
UNT? ";
6680 INPUT Y$
6690 PRINT Y$
6695 IF Z0=2 THEN LET L=L-PP
6700 IF Z0=1 THEN LET MG=MG-PP
6710 IF Y$="X" THEN LET X=X-PP
6720 IF Y$="S" THEN LET S=S-PP
6730 IF Y$="V" THEN LET V=V-PP
6740 PRINT
6745 PRINT T$
6750 IF Z0=1 THEN PRINT "NEW MOR
TGAGE BALANCE: $";MG
6760 IF Z0=2 THEN PRINT "NEW INS
. BALANCE: $";L
6770 PRINT S$
6900 PRINT "TYPE ""1"" IF YOU WI
SH TO TRANSFERBETWEEN ACCOUNTS,
""2"" TO RETURN TO START, ""3""
TO ENTER ANOTHER  LOAN PAYMENT,
""4"" TO SEE ACCOUNTBALANCES."
6910 INPUT KK
6915 CLS
6920 IF KK=2 THEN GOTO 5
6930 IF KK=3 THEN GOTO 6602
6940 IF KK=4 THEN GOTO 800
7000 CLS
7005 PRINT S$
7010 PRINT "AMT. YOU WISH TO TRA
NSFER: $";
7015 INPUT WE
7020 PRINT WE
7025 PRINT
7030 PRINT "FROM WHICH ACCOUNT?
";
7040 INPUT U$
7050 PRINT U$
7060 PRINT
7070 PRINT "TO WHICH ACCOUNT? ";
7080 INPUT V$
7090 PRINT V$
7100 IF U$="S" THEN LET S=S-WE
7110 IF U$="MA" THEN LET MA=MA-W
E
```

```
7120 IF W$="V" THEN LET V=V-WE
7130 IF W$="X" THEN LET X=X-WE
7140 IF W$="CD" THEN LET CD=CD-W
E
7150 IF W$="ST" THEN LET ST=ST-W
E
7160 IF W$="C" THEN LET C=C-WE
7170 IF W$="S" THEN LET S=S+WE
7180 IF V$="MA" THEN LET MA=MA+W
E
7190 IF V$="V" THEN LET V=V+WE
7200 IF V$="X" THEN LET X=X+WE
7210 IF V$="CD" THEN LET CD=CD+W
E
7220 IF V$="ST" THEN LET ST=ST+W
E
7230 IF V$="C" THEN LET C=C+WE
7235 PRINT T$
7240 PRINT
7250 PRINT "TYPE ""1"" IF YOU WI
SH TO MAKE    ANOTHER TRANSFER,
""2""  IF YOU    WISH TO RETURN T
O START, ""3"" TO SEE REVISED AC
COUNTS."
7260 INPUT JE
7265 CLS
7270 IF JE=1 THEN GOTO 7000
7275 IF JE=3 THEN GOTO 600
7280 GOTO 5
7500 CLS
7505 REM *MONTH BY MONTH INCOME/
EXPENSE, DIFFERENCE, AND MEANS*
7510 PRINT T$
7520 PRINT "    MONTHLY INCOME AN
D EXPENSE    "
7530 PRINT S$
7540 PRINT T$
7550 PRINT "MONTH";TAB 7;"INCOME
";TAB 14;"EXPENSE";TAB 22;"DIFFE
RENCE"
7560 PRINT S$
7570 LET H$="JANFEBMARAPRMAYJUNJ
ULAUGSEPOCTNOVDEC"
7571 LET MM=0
7572 LET II=0
7573 LET EE=0
7575 LET MO=3
7576 LET MM=1
7580 FOR B=1 TO 23 STEP 2
7585 LET W(B)=INT (W(B)+.5)
7586 LET W(B+1)=INT (W(B+1)+.5)
7600 PRINT H$(MM TO MO);TAB 8;W(
B);TAB 15;W(B+1);TAB 23;W(B)-W(B
+1)
7605 LET II=II+W(B)
7606 LET EE=EE+W(B+1)
7610 LET MO=MO+3
7620 LET MM=MM+3
7625 IF W(B)>0 THEN LET MM=MM+1
7630 NEXT B
7640 PRINT F$
7650 PRINT "TOTALS";TAB 8;II;TAB
 15;EE;TAB 23;II-EE
7660 PRINT T$
7670 PRINT "ENTER ""C"" TO INCLU
DE MORTGAGE."
7680 STOP
7690 CLS
7700 PRINT T$
7710 PRINT TAB 7;"INCOME";TAB 14
;"EXPENSE";TAB 22;"DIFFERENCE"
7720 PRINT S$
7725 PRINT
7730 PRINT TAB 8;II;TAB 15;EE;TA
B 23;II-EE
7735 PRINT F$
7740 LET PP=INT (MGX-MG)
7750 PRINT "PRIN.";TAB 0;"PMTS."
;TAB 15;PP
7760 PRINT F$
7770 PRINT "YEAR";TAB 8;II;TAB 1
5;EE+PP;TAB 23;II-EE-PP
7780 PRINT
7790 PRINT S$
7791 LET BB=0
7792 FOR B=1 TO 24 STEP 2
7793 LET AA=R(B)
7794 LET BB=BB+AA
7795 NEXT B
7800 PRINT "MEAN MONTHLY INCOME:
 $";INT ((II/HH)*10**2+.5)/10
**2
7810 PRINT "MEAN MONTHLY EXPENSE
**: $";INT ((EE/HH)*10**2+.5)/10
**2
7816 PRINT "MEAN EXPENSE LAST YR
**: $";INT ((BB/12)*10**2+.5)/10
**2
7818 PRINT "(**EXCLUDING MORTGAG
E)"
7820 PRINT S$
7830 PRINT "ENTER ""C"" TO RETUR
N TO START."
7840 STOP
7850 GOTO 5
```

Ed.—For the convenience of our readers the author will supply the program on cassette for $8 including postage. Readers outside the U.S. should include in the payment enough to cover the additional cost of postage for about 2 ounces. ■

Line Notes:

7: S

11: S

15: Inverse: MONEY MANAGER

70: Letter O

210: Once you have entered your income categories, delete statements indicated in REM.

223: 6

225: 5, 8

230: 7

255: Your income categories

464: IF, LET statements credit the income to the proper account.

486: Prints a running total of both monthly and year-to-date income.

505: Once you have entered your expense categories, delete statements indicated in REM.

512: 6

515: 5, 8

518: 7

722: IF, LET statements debit the appropriate account.

810: Initialize each asset and liability balance with LET statements.

827: 5, 8

828: 7

865: Change titles of assets and liabilities to suit your own needs.

875: Inverse > on M

893: Inverse > on M

896: Inverse spaces; > on M

1020: 6

1025: 5, 8

1030: 7

1695: These 3 statements set up your graph but should be deleted after running. R(1) would be Jan. expenses last year; R(3) Feb., etc. These will only appear on the graph when you enter each month this year, but they will be in memory waiting.

2575: 6

2580: Inverse space

2588: A

2620: 81 represents last year (change to suit your needs); space between each letter representing a month; 82 represents this year.

3006: Delete statements in REM after entering all your budget items.

3010: 6

3015: 5, 8

3020: 7

3590: Delete statements indicated in REM after running 3600.

4065: Letter O

4080: Letter O

4570: 3

4575: 6

4580: 8

4585: D

4588: A

5030: Space between each letter.

6010: 6

6020: 5, 8

6608: Change loan titles to suit your own needs.

7520: A (2), A (2)

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Authors note to players — I wrote this one with a concordance in hand. It is very accurate — and a lot of fun. It was nice to wander around the ship instead of watching it on T.V.

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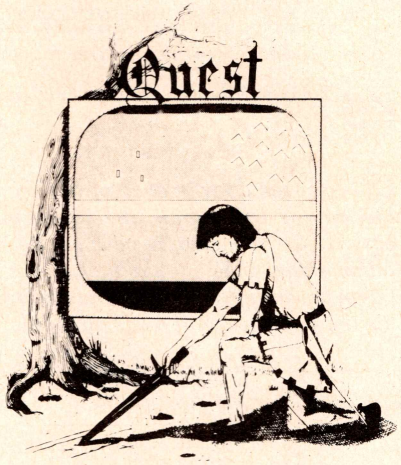

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EARTHQUAKE by Bob Anderson and Rodger Olsen — A second kids adventure. You are trapped in a shopping center during an earthquake. There is a way out, but you need help. To save yourself, you have to be a hero and save others first.

Authors note to players — This one feels good. Not only is it designed for the younger set (see note on Haunted House), but it also plays nicely. Instead of killing, you have to save lives to win this one. The player must help others first if he/she is to survive — I like that.

PYRAMID by Rodger Olsen — This is one of our toughest Adventures. Average time through the Pyramid is 50 to 70 hours. The old boys who built this Pyramid did not mean for it to be ransacked by people like you.

Authors note to players — This is a very entertaining and very tough adventure. I left clues everywhere but came up with some ingenous problems. This one has captivated people so much that I get calls daily from as far away as New Zealand and France from bleary eyed people who are stuck in the Pyramid and desperate for more clues.

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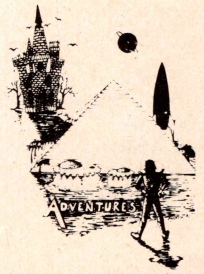
MARS by Rodger Olsen — Your ship crashed on the Red Planet and you have to get home. You will have to explore a Martian city, repair your ship and deal with possibly hostile aliens to get home again.

Authors note to players — This is highly recommended as a first adventure. It is in no way simple—playing time normally runs from 30 to 50 hours — but it is constructed in a more "open" manner to let you try out adventuring and get used to the game before you hit the really tough problems.



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Checkbook Management

George J. Repicky

A computer with its TV display, makes the task of updating and balancing a checkbook simpler than using a four-function calculator. The display enables the user to double-check entries and so helps eliminate mistakes. In addition, if mistakes are made, they are easily corrected. Below are two programs which I developed for these purposes. Each requires the 8K ROM, and each fits into 1K RAM.

Program 1

If you are like most people, you make a number of transactions—write checks, make deposits, etc.—with your checkbook before you update the balance. The first of the two programs is designed to update your checkbook balance. To use the program, enter it into the computer, then RUN.

The program first asks you to

INPUT BALANCE

At this point you enter your last computed balance.

Then the program asks you to

INPUT CHECK CHARGE

In response, you enter the per check charge of your account. (If your checking account has no check charge, you can delete lines 220 and 230, and the "-C" of line 380, from the program.)

The program then clears the screen, and displays:

INPUT CODE, THEN INPUT AMT.
ITEM DEBIT CREDIT BALANCE

At this point you enter each transaction in your checkbook in two steps. First, for each transaction you enter a code: 0 if the transaction was a debit (a monthly service charge, for example); 1 if the transaction was a credit (a deposit, perhaps); or the check number if the transaction was a check. Second, you enter the amount of the transaction. After each complete entry the computer displays the nature of the transaction in the first column, using DEB if the transaction was a debit, CRED if the transaction was a credit, or the check number if the transaction was a check; the amount of the transaction in the second (if the transaction was a debit or check) or third (if the transaction was a credit) column; and the resulting balance in the fourth column.

For an example of how this works, suppose that your most recent balance was $110.10 and that your account charges you $0.25 per check. Upon entering these figures, the display would show

INPUT CODE, THEN INPUT AMT.
ITEM DEBIT CREDIT BALANCE
110.1

Now suppose your next four transactions were check 215 for $50.; a $3.00 monthly service charge; a $240 deposit; and check 216 for $245.20. To enter these you would enter 215, then 50; 0 (for a debit), then 3; 1 (for a credit), then 240; and 216, then $245.20. The display would now show:

INPUT CODE, THEN INPUT AMT.

ITEM	DEBIT	CREDIT	BALANCE
			110.1
215	50		59.85
DEB	3		56.85
CRED		240	296.85
216	245.20		51.4

This display scrolls up with each entry, so you may continue until you have entered all transactions. The screen can hold eleven transactions at one time, so be sure you check your work from time to time. If you should detect an error, it can be offset using the 0 or 1 code, and then the amount, to adjust the balance appropriately.

Program 2

The second program is used to check your checkbook balance against your bank statement. When you run the program, it first asks you to

INPUT CHECK CHARGE

In response, you enter your account per-check charge. If your account does not have a check charge, you can delete lines 80, 90, and 100, and the "-A" of line 190. Alternatively, if you will use the program for accounts with the same check charge, you can make line 80:

80A = (check charge) and delete lines 90 and 100.

The program then asks you to

INPUT BANK BALANCE

In response, you enter your balance as per your bank statement.

The program then asks you to

INPUT OUTSTANDING CHECKS
IF FINISHED, INPUT 0

You now enter, one at a time, the amount of each check which was not returned with the statement. As you enter the amount of each check, it is displayed on the screen. When you have entered all such checks, enter 0.

This sends the program on to the next step which asks you to

INPUT UNRETURNED DEPOSITS
IF FINISHED INPUT 0

Now you enter, one at a time, the amount of each deposit which you made since the statement was compiled by the bank, that is, the amount of each deposit which does not appear on the statement. As you enter the amount of each such deposit, its value will appear on the screen. When you are finished, enter 0. The computer will now compute your correct checkbook balance (assuming the bank has not made a mistake!) and display

CHECKBOOK BALANCE SHOULD BE:
(balance)

Memory Saving

In entering the program, you should use keywords and tokens wherever possible in the PRINT statements. This saves considerable memory and is necessary if the program is to run in 1K RAM.

To use this procedure (from Richard McDaniel, *SYNC* 1:5) enter the line number, then enter the last keyword in the statement. Then back up the cursor, using the left arrow

George J. Repicky, 49 Roosevelt Ave., Schenectady, NY 12304.

(shift 5) until it is before the keyword. Now enter the next-to-last keyword. Repeat this procedure until all keywords are entered. You can enter intermediate text as you work, or after all keywords are entered.

An example may help here. Consider line 260 from the first program:

260 PRINT "INPUT CODE, THEN INPUT AMT."

To enter this line, first type:

260 INPUT AMT."

using the keyword INPUT (on the "I" key). Then back up using the left arrow (shift 5) until the cursor is before the word INPUT. Now enter THEN, using the token (shift 3). The display will read:

260 THEN INPUT AMT."

Back up again until the cursor is before THEN, and enter CODE, using the token. To do this you must first obtain the function cursor (shift NEWLINE or shift ENTER), then enter the token CODE, (on the "I" key). The display will now read:

260 CODE THEN INPUT AMT."

The cursor is now after the word CODE, so now is a good time to enter the comma. Next, back up again until the cursor is before the word CODE, and enter INPUT, again using the keyword (on the I key). The display now reads:

260 INPUT CODE, THEN INPUT AMT."

Finally, back up again until the cursor is before the word INPUT, and enter PRINT, using the keyword (on the "P" key). At this time also enter the leading quotation mark. The display will now show the complete line, ready to enter:

260 PRINT "INPUT CODE, THEN INPUT AMT."

The whole thing sounds a bit complicated when you read it, but it is really quite simple once you get the hang of it. The memory saving is substantial; 17 bytes for this one statement alone. ■

Program 1. Checkbook Update.

```
 200 PRINT " INPUT BALANCE"
 210 INPUT B
 220 PRINT " INPUT CHECK CHARGE"
 230 INPUT C
 240 CLS
 250 SCROLL
 260 PRINT " INPUT CODE , THEN I
NPUT AMT."
 270 GOSUB 2000
 280 PRINT "ITEM";TAB 5;"DEBIT";
TAB 13;"CREDIT";TAB 21;"BALANCE"
 290 GOSUB 2000
 300 PRINT TAB 21;B
 310 GOSUB 2000
 320 INPUT Y
 340 INPUT Z
 350 IF Y=1 THEN GOTO 1000
 360 LET B=B-Z
 370 IF Y>1 THEN PRINT Y;
 380 IF Y=0 THEN PRINT "DEB";
 390 IF Y>1 THEN LET B=B-C
 400 PRINT TAB 5;Z;TAB 21;B
 410 GOTO 310
1000 LET B=B+Z
1010 PRINT "CRED";TAB 12;Z;TAB 2
1;B
1020 GOTO 310
2000 SCROLL
2010 PRINT
2020 SCROLL
2030 RETURN
```

Line notes:

210: Enters the previous checkbook balance.

230: Enters the per check charge.

280: Sets the headings of the transaction listing.

300: Prints previous balance in col. 4.

320: Enters code -0, 1, or check no.

340: Enters amount of transaction.

350: Branch if transaction was a credit.

360: Decreases balance for debits.

370: Prints check no. if transaction was a check.

380: Prints DEB if transaction was a non-check debit.

390: Decreases balance by per check charge if transaction was check.

400: Prints amt. of trans. and resulting balance.

410: Returns for next transaction.

1000: Branch from 350; increases bal. for credit.

1010: Prints amt. of trans. and resulting balance.

1020: Returns for next transaction.

2000: Scroll and space subroutine; used after each line of display is printed.

2030 RETURN

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Program 2. Checkbook Statement Comparison.

```
  70 GOSUB 2000
  80 PRINT " INPUT CHECK CHARGE"
  90 INPUT A
 100 GOSUB 2000
 110 PRINT " INPUT BANK BALANCE"
 120 INPUT B
 130 GOSUB 2000
 140 PRINT " INPUT OUTSTANDING C
HECKS"
 150 GOSUB 2000
 160 GOSUB 4000
 170 INPUT C
 180 IF C=0 THEN GOTO 230
 190 LET B=B-C-A
 200 PRINT C
 210 GOSUB 2000
 220 GOTO 170
 230 GOSUB 2000
 240 PRINT " INPUT UNRETURNED DE
POSITS"
 250 GOSUB 2000
 260 GOSUB 4000
 270 INPUT D
 280 IF D=0 THEN GOTO 340
 290 LET B=B+D
 300 PRINT D
 310 GOSUB 2000
 320 GOTO 270
 330 GOSUB 2000
 340 PRINT "BALANCE SHOULD BE: "
;B
1999 STOP
2000 SCROLL
2010 PRINT
2020 SCROLL
2030 RETURN
4000 PRINT "IF FINISHED INPUT 0"
4010 GOSUB 2000
4020 RETURN
```

Line notes:

90: Inputs per check charge

120: Inputs bank balance as per statement.

170-230: Form a loop which inputs outstanding checks and adjusts the bank statement balance for them and associated per check charges.

240-330: Adjust the bank statement balance for any deposits made after the statement was prepared.

340: Prints checkbook balance.

2000: Subroutine used to scroll and space printout.

4000: Subroutine to print statement.

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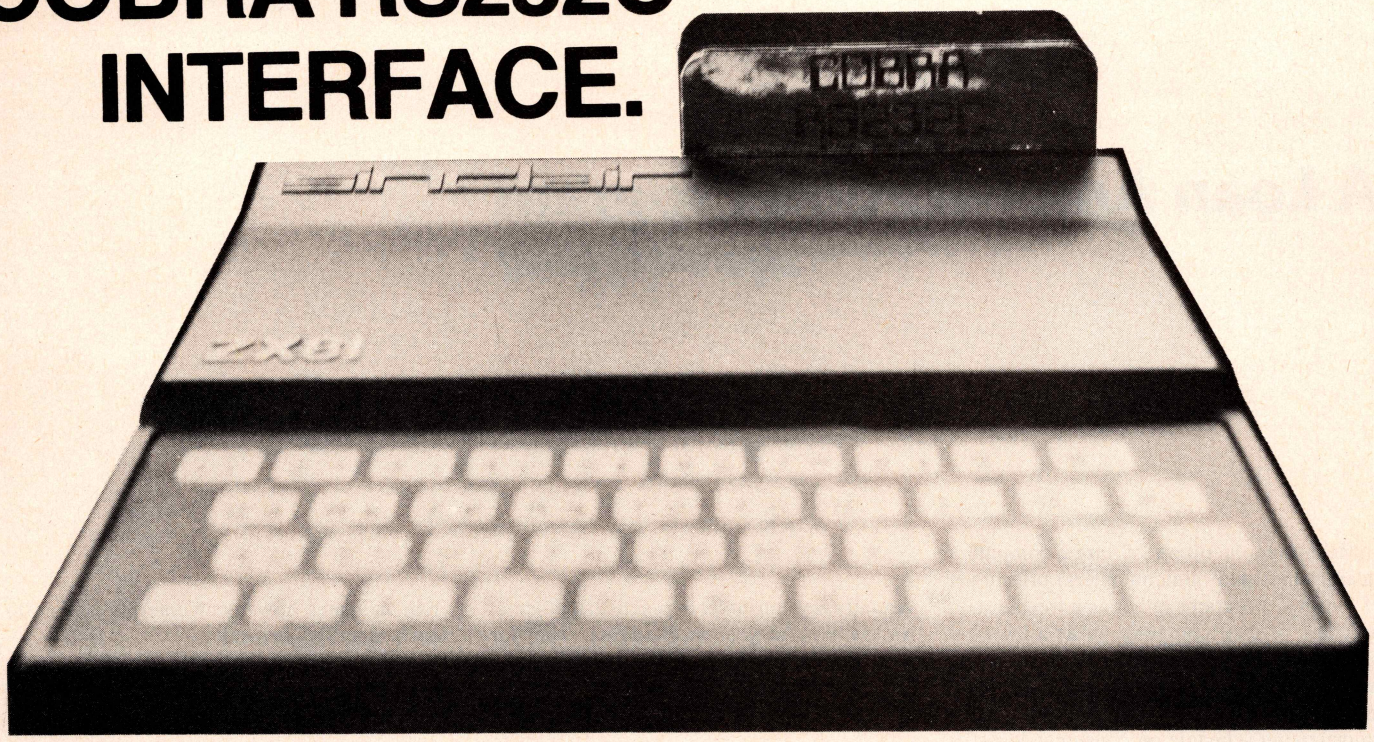

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A Loan Amortization Program

Gerald F. Hoag

Most manufacturers of large computers (mainframes and minicomputers) offer a set of "utility" programs either as a freebie with purchase of their computer, or as a low cost option. One program that inevitably shows up in those packages is a loan amortization program for calculating monthly payments and an amortization schedule on consumer loans or home mortgages. The usefulness of such information is obvious. The payment tells the user how much of a monthly commitment he is making, and the amortization schedule how much of the payment is being applied to interest and how much to reduce the balance on the loan.

Most loan amortization programs ask the user to specify three out of the following four items of information: the amount of the loan (the principle), the annual interest rate, the duration of the loan, and the amount of each payment. The program then calculates the missing variable and prints out the amortization schedule. Usually that is printed out in a columnar format with the payment number in one column and the following items in the other columns: the payment amount, the amount of the payment that went for interest, the amount that went towards repayment of the principle, and the remaining balance on the principle.

Since I have a ZX80 (8K ROM) with only 1K of user memory, I knew that I would not be able to deal with a lot of options, nor would I be able to do an entire amortization schedule. I decided that the operator would supply the loan amount, the interest rate, and the number of monthly payments. The program would calculate only the payment necessary to amortize the loan. If I had room left over after the basic program was coded, I would see what could be done about an amortization schedule.

I first needed to find a formula for calculating the equal loan payments needed to amortize a loan. Such a formula can be found in virtually any consumer or practical mathematics textbook at your local library. That formula is seen cn Figure 1.

Gerald F. Hoag, 5112 16th Ave. So., Minneapolis, MN 55417.

Figure 1. Loan Repayment Formula.

$$\text{payment} = \text{loan amount} \times \frac{\text{periodic int. rate}}{1 - \frac{1}{(1 + \text{periodic int. rate})^{\text{periods}}}}$$

Before I started programming, I verified the formula by calculating a payment using a calculator and comparing the result with the payment amount listed in a loan payment book.

With a formula in hand, it was easy to come up with the statements needed to ask for input from the operator and to calculate the periodic interest rate. Those steps are handled in lines 10 through 70 of the program (shown in Figure 2). As shown, the information input by the operator is printed out as soon as it is entered to form a record of the loan parameters and as a convenience to the operator.

The periodic interest rate is found by dividing the annual interest rate by the number of payment periods in a year (the program assumes 12 payments per year). That interest rate indicates how much interest applies to each monthly payment.

Calculating the monthly payment, however, was a trickier problem. When I first wrote the program, I tried entering the payment calculation in one long program statement in algebraic format:

```
LET PAYMENT = P * I/(1-(1/(1+I)**MO))
```

Besides the obvious difficulty in trying to get a valid statement with so many parentheses, I also was getting the wrong answers because of the priority in which the ZX80/81 handles calculations (first exponentiation, then multiplication and division, and finally addition and subtraction). This produces wrong answers even though the formula is algebraically correct.

I decided to simplify the calculations, and also to get them in the proper sequence for calculation by first calculating the divisor of the formula as shown in the series of steps in lines 80, 90, and 100. Then, after I had the divisor, I could use a more simplified formula to calculate the monthly payment, as shown in line 110.

Lines 120, 130, and 140 print out the calculated monthly payment and then the headings for an amortization schedule. With a little experimentation, I discovered that I would have enough memory left over to show the amortization of one payment. Line 145, therefore, sets the payment number equal to 1. That is followed by calculation of the interest paid in the period, the reduction to the principle, and the balance remaining on the principle. For those with more memory, line 145 would be the appropriate place to start a FOR/NEXT

Figure 2. Loan Amortization Program (1K).

```
  10 PRINT "AMOUNT OF LOAN?"
  20 INPUT AMT
  25 PRINT AMT
  30 PRINT "ANNUAL INTEREST RATE
?"
  40 INPUT RAT
  45 PRINT RAT
  50 PRINT "LOAN DURATION (MONTH
S)?"
  60 INPUT MO
  65 PRINT MO
  70 LET INT=(RAT/100)/12
  80 LET DIVISOR=1+INT
  90 LET DIVISOR=DIVISOR**MO
 100 LET DIVISOR=1-(1/DIVISOR)
 110 LET P=AMT*(INT/DIVISOR)
 120 PRINT "PAYMENT=";P
 130 PRINT
 140 PRINT "NO. INT PAID REDUCTI
ON BALANCE"
 145 LET I=1
 150 LET INTPAID=AMT*INT
 160 LET RED=P-INTPAID
 170 LET AMT=AMT-RED
 190 PRINT I;"   ";INTPAID;" ";RE
D;" ";AMT
```

loop to calculate a complete schedule. Just let the loop count equal the number of monthly payments ("MO") and execute lines 150, 160, 170, and 190 on each pass through the loop. Specifically, the NEXT statement in the loop would go on a line after line 190.

Figure 3. Sample Run (1K).

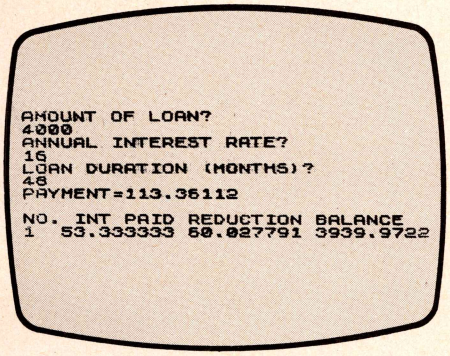

Figure 4. Sample Run (over 1K).

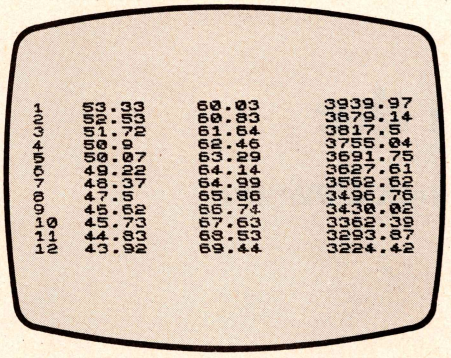

Figure 5.
Additions to Figure 2 for over 1K RAM.

```
135 SCROLL
145 FOR I=1 TO 48
147 SCROLL
190 PRINT I;TAB 4;INT (INTPAID*
100+.5)/100;TAB 13;INT (RED*100+
.5)/100;TAB 23;INT (AMT*100+.5)/
100
200 NEXT I
```

Figure 3 shows a sample run of the program with the operator entering the amount of the loan, the annual interest rate, and the loan duration. The program echoes each of those entries by printing them back out. Following entry of the loan duration, the program calculates and prints out the amount of the monthly payment and then the one month amortization. As you can see, a good project for those with more memory would be a routine to round off the results to two decimal places!

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8K ROM
2K RAM

Keeping Time in the Home Office

Chuck Dawson

Since the Sinclair computers have an internal timing feature, they can be used to make a clock display which will give you the time. Two basic programs are given below to do just that.

A Digital Clock

The first program provides you with a digital clock. The display will show the time in digits about three inches high and extending all across the screen.

Lines 130 and 140 control the timing. Line 130 counts the number of frames sent to the television since the last PAUSE and then holds until a specified number is reached. The PAUSE in the next line is used to fine tune things and also reset the frame counter for the next minute's cycle.

If your computer is capable of SLOW mode, you will see a display which stays rock steady until a minute passes and the last digit slowly changes itself into the next appropriate number. In the SLOW mode it does not always take exactly the same amount of time to update the display. I have noticed that, if the memory is nearly full, the computer seems to take longer to compute.

In the FAST mode, this trick will not work since no frames are sent during the compute cycle. So change line 130 to a PAUSE 3288 and line 140 to POKE 16437,255. The large numbers themselves are generated by PEEKing into the ROM's own character generating routine and enlarging it eight times. For faster updating, only the middle six lines are used. There are blank lines above and below each character so there is no reason to waste time reproducing these.

After you have typed in the program, use GOTO 700 to SAVE. The program will then run itself.

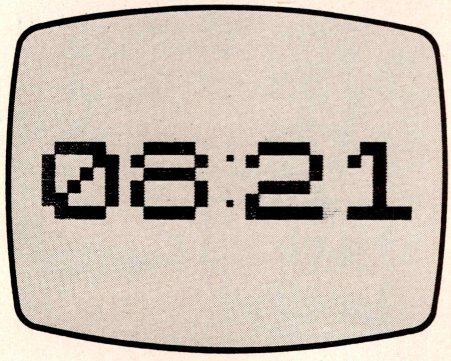
Chuck Dawson, 6520 Victoria, Fort Worth, TX 76118.

Listing 1. Digital Clock.

```
  10 REM "DIGITAL CLOCK" TO SAVE
GOTO 700
  15 PRINT " INPUT TIME"
  20 INPUT TIME
  25 CLS
  30 LET M=INT (TIME/100)*60+TIM
E-INT (TIME/100)*100
  35 GOTO 140
  40 LET T=0
  50 LET D=INT ((INT (M/60))/10)
  55 GOSUB 500
  60 LET T=7
  65 LET D=(INT (M/60))-10*D
  70 GOSUB 500
  75 PLOT 31,20
  80 PLOT 31,27
  85 LET T=16
  90 LET D=INT (60*(M/60-INT (M/
60))/10+.05)
  95 GOSUB 500
 100 LET T=23
 110 LET D=M-INT (M/10)*10
 120 GOSUB 500
 130 IF PEEK 16437<>245 THEN GOT
O 130
 140 PAUSE 1248
 150 LET M=M+1
 160 IF M=1440 THEN LET M=0
 170 GOTO 40
 500 LET N=7905+D*8
 505 PRINT AT 7,T;
 510 FOR N=N TO N+5
 515 LET X=PEEK N
 520 FOR L=1 TO 7
 525 LET C=0
 530 IF X<128 THEN GOTO 560
 540 LET C=128
 550 LET X=X-128
 560 LET X=X*2
 570 PRINT CHR$ C;
 580 NEXT L
 585 PRINT TAB T;
 590 NEXT N
 600 RETURN
 700 SAVE "DIGITAL CLOCK"
 710 RUN


 160 IF M=780 THEN LET M=60
 502 IF T=0 AND D=0 THEN LET N=7
681
```

Program 1. Digital Clock.



The Face Clock

The second program will give a display with the traditional face clock. The face is drawn only once and then the hands are PLOTed in and UNPLOTed when no longer needed. This program is suggested by an exercise in the chapter on time and motion in the ZX81 manual.

Listing 2. Hand Clock.

```
  10 REM "FACE CLOCK" TO SAVE GO
TO 500
  12 PRINT " INPUT TIME"
  14 INPUT T
  16 LET H=2*INT (T/100)
  18 LET T=T-100*INT (T/100)
  20 IF T>15 THEN LET H=H+1
  22 IF T>45 THEN LET H=H+1
  24 CLS
  26 FAST
  30 FOR D=1 TO 12
  40 PRINT AT 10-10*COS (D/6*PI)
,13+10*SIN (D/6*PI);D
  50 NEXT D
  60 SLOW
  65 POKE 16437,250
  70 GOTO 150
  80 LET P=0
  90 LET C=X
 100 LET D=Y
 110 GOSUB 1000
 120 LET T=T+1
 130 IF T=60 THEN LET T=0
 140 IF T=16 OR T=46 THEN GOTO 2
50
 150 LET P=1
 160 LET L=T/30*PI
 170 LET X=27+18*SIN L
 180 LET Y=22+18*COS L
 190 LET C=X
 200 LET D=Y
 210 GOSUB 1000
 220 GOSUB 310
 230 IF PEEK 16437>241 THEN GOTO
 230
 235 PAUSE 219
 240 GOTO 80
 250 LET H=H+1
 260 GOTO 24
 310 LET P=1
 320 LET A=27
 330 LET B=22
 340 LET G=H/12*PI
 350 LET C=27+12*SIN G
 360 LET D=22+12*COS G
 370 GOSUB 1000
 380 RETURN
 500 SAVE "FACE CLOCK"
 510 RUN
1000 LET A=27
1002 LET B=22
1006 LET U=C-A
1010 LET V=D-B
1020 LET O=SGN U
1030 LET L=SGN V
1040 LET Z=SGN U
1050 LET Q=0
1060 LET M=ABS U
1070 LET N=ABS V
1080 IF M>N THEN GOTO 1130
1090 LET Z=0
1100 LET Q=SGN V
1110 LET M=ABS V
1120 LET N=ABS U
1140 LET S=INT (M/2)
1150 FOR I=0 TO M
1160 IF P=1 THEN PLOT A,B
1165 IF P=0 THEN UNPLOT A,B
1170 LET S=S+N
1180 IF S<M THEN GOTO 1230
1190 LET S=S-M
1200 LET A=A+O
1210 LET B=B+L
1220 GOTO 1250
1230 LET A=A+Z
1240 LET B=B+Q
1250 NEXT I
1260 RETURN
```

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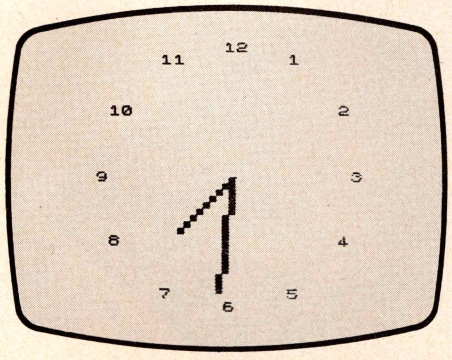
If you have only 2K RAM, you will find that this program fills up almost all available space. If you have a 16K module, you can add the second hand and other decorative touches.

After you have typed in the program, use GOTO 500 to SAVE. The program will then run itself.

Setting Your Clock

In both programs, after the program is running, you are asked to input the time. Do not use a colon; just enter the figures: Not 3:45 but 345.

Program 2. Face Clock.



A Calendar

From time to time we want to see how a certain month falls in the calendar or what day of the week a certain date is on. Most calendars show only one year on either side of the calendar year. Thus dates beyond the printed calendar have to be calculated laboriously by hand with the danger that we may have overlooked a day in an irregular month. This program provides the solution to the problem.

With this program you can enter any month and any year, and the computer will show you the calendar for that month. Well, not exactly any year. It has to be between September 14, 1752, and February 28, 2200. Nevertheless that range covers most dates of interest.

After you have typed in the program, use GOTO 300 to SAVE. The program will then run itself. The prompts will call for inputting the month and year. Type in at least the first three letters of the month and hit ENTER; then type in the year and hit ENTER. The computer will then display the calendar for that month. You can use either FAST or SLOW mode but remember that it takes much longer to produce the calendar in the SLOW mode.

To test whether the program is working right, try DECEMBER 1941. We remember that the 7th was on a Sunday. Now try some other dates. Try your birth month and year. I use this program to plan business trips and vacations for the coming year even before I start getting those free calendars in the mail in December.

This is a good program for showing off your computer to your friends. Try it at your next party.

Program 3. Calendar.

```
        JANUARY 1983

SUN MON TUE WED THU FRI SAT
                        1
 2   3   4   5   6   7   8
 9  10  11  12  13  14  15
16  17  18  19  20  21  22
23  24  25  26  27  28  29
30  31
```

```
        FEB 6000

SUN MON TUE WED THU FRI SAT
            1   2   3   4   5
 6   7   8   9  10  11  12
13  14  15  16  17  18  19
20  21  22  23  24  25  26
27  28  29
```

```
        FEB 999999

SUN MON TUE WED THU FRI SAT
    1   2   3   4   5   6
 7   8   9  10  11  12  13
14  15  16  17  18  19  20
21  22  23  24  25  26  27
28
```

Listing 3. Calendar.

```
  5 REM "CALENDAR" TO SAVE GOTO
300
 10 LET A$="CDJANFEBMARAPRMAYJU
NJULAUGSEPOCTNOVDECSUN MON TUE W
ED THU FRI SAT"
 15 PRINT " INPUT MONTH"
 20 INPUT B$
 25 FOR M=1 TO 12
 30 IF B$(1 TO 3)=A$(3*M TO 3*M
+2) THEN GOTO 45
 35 NEXT M
 40 GOTO 20
 45 PRINT " INPUT YEAR"
 50 INPUT Y
 55 IF Y<1752 THEN GOTO 50
 60 CLS
 65 PRINT AT 3,8;B$;" ";Y
 70 PRINT AT 6,0;A$(39 TO )
 75 GOSUB 200
 80 PRINT AT 8,Z*4;
 85 LET M=M+1
 90 GOSUB 200
 95 IF Z=0 THEN LET Z=7
100 FOR I=1 TO 31
110 PRINT " ";I;" ";
120 IF I<10 THEN PRINT " ";
130 IF I>27 AND 33-PEEK 16441=Z
*4 THEN STOP
140 IF PEEK 16441=5 THEN PRINT
;;;
150 NEXT I
200 LET X=0
210 IF M=1 OR M=2 THEN LET X=1
220 LET L=Y-X
230 LET X=M+X*12
240 LET P=INT (L/100)
250 LET Z=INT (13*(X+1)/5)+INT
(5*L/4)+INT (P/4)-P
260 LET Z=Z-7*INT (Z/7)
270 RETURN
300 SAVE "CALENDAR"
310 RUN
```

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8K ROM (4K ROM)
1K RAM

Calculating the Days

Ronald Paludan

Knowing the number of days between two dates is frequently necessary for calculating interest, apportioning expenditures, or calculating average use of items. We are also interested in the more trivia type questions such as how many days before an important date, how many days between certain historical dates, and even how many days we have lived.

This program will enable you to determine the number of days between dates either for serious use or just curiosity. The program in Listing 1 is for the 8K ROM machine with 1K RAM. A 4K ROM adaptation is included in Listing 2.

Operating Instructions

1) Type in the program in Listing 1. Hit RUN and ENTER.

2) The prompts will ask the user to ENTER FIRST DATE. Do so in this order: Type in the month as a number from 1 to 12 and hit ENTER. Type in the day of the month and ENTER. Finally, type in the year giving all four digits and ENTER.

3) Repeat this process for the second date. The first date must be earlier than the second. On the 4K ROM the two dates cannot be more than 88 years apart, but a method is supplied for dealing with this problem.

4) The answer will then be given on the screen.

5) To repeat, hit ENTER. To quit, hit any number or letter and then ENTER.

Error Checking

The input routine does not allow the user to enter more than 12 for a month or 31 for a day. The user with enough memory may want to add a more detailed error checking routine that rejects nonexistent dates, e.g., June 31.

Modifications for the 4K ROM

Listing 2 gives the lines which must be altered to allow the program to operate properly on the 4K ROM (ZX80 or MicroAce).

4K ROM Problem: Dates more than 88 Days apart

The integer Basic of the 4K ROM ZX80 will not handle numbers greater than 32767. For this reason, the program will reject the second year if it is more than 88 years after the first. However, there is a method for finding the number of days between two dates more than 88 years apart. This method requires the use of one or more mid-date(s) which must be less than 89 years from the date next to it in the series. The number of days between the first date and the mid-date is computed and the results recorded. Then the number of days between the mid-date and the second date is computed and added manually to the first result.

Listing 1.
Days between Two Dates (8K ROM).

```
  20 DIM N(12)
  25 LET N(1)=0
  30 LET N(2)=31
  35 LET N(3)=59
  40 LET N(4)=90
  45 LET N(5)=120
  50 LET N(6)=151
  55 LET N(7)=181
  60 LET N(8)=212
  65 LET N(9)=243
  70 LET N(10)=273
  75 LET N(11)=304
  80 LET N(12)=334
  85 LET D=0
  90 PRINT "                              M
/D/Y"
 100 PRINT "ENTER FIRST DATE: ";
 110 INPUT M1
 112 IF M1>12 THEN GOTO 110
 120 PRINT M1;"/";
 130 INPUT D1
 132 IF D1>31 THEN GOTO 130
 140 PRINT D1;"/";
 150 INPUT Y1
 160 PRINT Y1
 170 PRINT "ENTER SECOND DATE: "
;
 180 INPUT M2
 185 IF M2>12 THEN GOTO 180
 190 PRINT M2;"/";
 200 INPUT D2
 205 IF D2>31 THEN GOTO 200
 210 PRINT D2;"/";
 220 INPUT Y2
 225 IF Y2-Y1>88 OR Y2<Y1 THEN G
OTO 220
 230 PRINT Y2
 240 FOR X=Y1 TO Y2-1
 250 LET D=D+365
 255 IF INT (X/100)*100=X AND IN
T (X/400)*400<X THEN GOTO 265
 260 IF INT (X/4)*4=X THEN LET D
=D+1
 265 NEXT X
 270 IF Y1=Y2 THEN LET D=365-D
 275 IF INT (Y1/100)*100=Y1 AND
INT (Y1/400)*400<Y1 THEN GOTO 28
5
 280 IF INT (Y1/4)*4=Y1 AND M1>2
 THEN LET D=D-1
 285 IF INT (Y2/100)*100=Y2 AND
INT (Y2/400)*400<Y2 THEN GOTO 30
0
 290 IF INT (Y2/4)*4=Y2 AND M2>2
 THEN LET D=D+1
 300 LET D=D-N(M1)-D1
 310 LET D=D+N(M2)+D2
 315 IF Y1=Y2 THEN LET D=D-365
 320 PRINT D;" DAYS APART"
 330 INPUT Y$
 340 CLS
 350 IF Y$="" THEN GOTO 20
```

Listing 2. 4K ROM Adaptations.

```
 255 IF 100*(X/100)=X AND 400*(X
/400)<X THEN GO TO 265
 260 IF 4*(X/4)=X THEN LET D=D+1
 270 IF Y1=Y2 THEN LET D=D-365
 275 IF 100*(Y1/100)=Y1 AND 400*
(Y1/400)<Y1 THEN GO TO 285
 280 IF 4*(Y1/4)=Y1 AND M1>2 THE
N LET D=D-1
 285 IF 100*(Y2/100)=Y2 AND 400*
(Y2/400)<Y2 THEN GO TO 300
 290 IF 4*(Y2/4)=Y2 AND M2>2 THE
N LET D=D+1

 315   Delete
```

As an example of how this method works, let's calculate how many days apart July 7, 1881, and January 1, 1981 are.

ENTER FIRST DATE: 7/7/1881
ENTER SECOND DATE: 1/1/1921
(mid-date)
14423 DAYS APART

(ENTER)

ENTER FIRST DATE: 1/1/1921
(mid-date)
ENTER SECOND DATE: 1/1/1981
21915 DAYS APART

14423
+ 21915

36338 Days apart

Variables Used

N(n)	Days used in year by nth month
D	Day counter (Number of days between dates)
M1	Month of 1st date
D1	Day of month for 1st date
Y1	Year of 1st date
M2	Month of 2nd date
D2	Day of month for 2nd date
Y2	Year of 2nd date
X	Temporary variable used as counter

Routines

The routines are found at the following lines:

20-85: Initialization.
95-230: Input dates.
240-310: Count days between dates. Compensate for leap years.
320: Print results.
330-340: Input ""to repeat.

Examples

The American Civil War lasted from February 8, 1861, to May 26, 1865. How many days did it last?

```
                              M/D/Y
ENTER FIRST DATE: 2/8/1861
ENTER SECOND DATE: 5/26/1865
1568 DAYS APART
```

John has a report due on July 20, 1982, and today is May 15, 1982. How many days does he have to complete the report?

```
                              M/D/Y
ENTER FIRST DATE: 5/15/1982
ENTER SECOND DATE: 7/20/1982
66 DAYS APART
```

Herb was born on August 1, 1945. How many days old will he be on his 40th birthday?

```
                              M/D/Y
ENTER FIRST DATE: 8/1/1945
ENTER SECOND DATE: 8/1/1985
14610 DAYS APART
```

```
                              M/D/Y
ENTER FIRST DATE: 1/1/1980
ENTER SECOND DATE: 4/1/1980
91 DAYS APART

                              M/D/Y
ENTER FIRST DATE: 1/1/1979
ENTER SECOND DATE: 4/1/1979
90 DAYS APART
```

Ronald Paludan, 3730 N. Oracle, 41, Tucson, AZ 85705.

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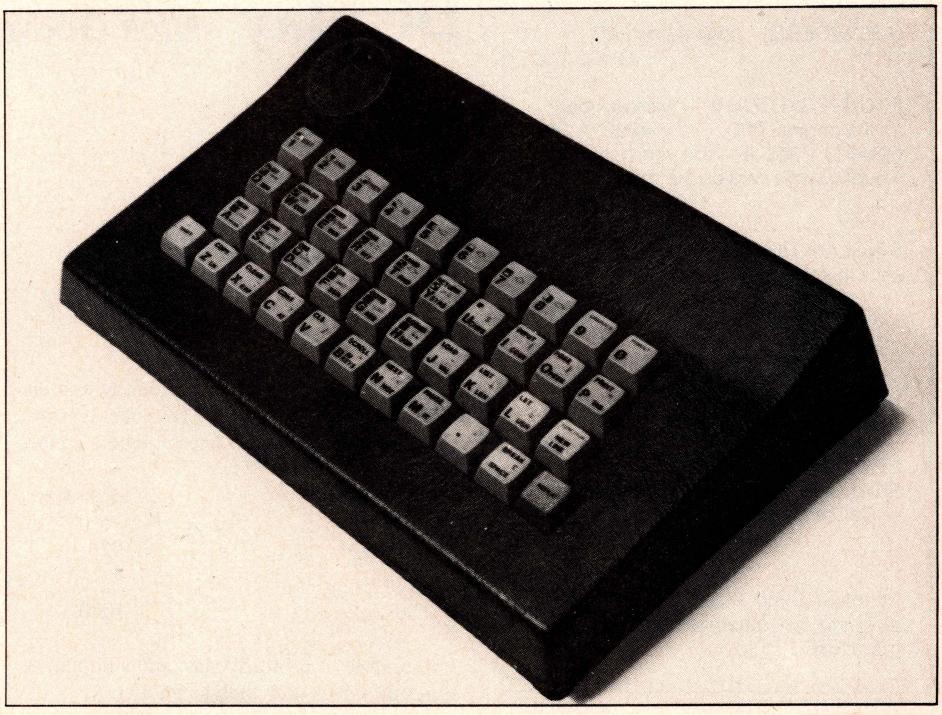

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8K ROM
1K RAM

Tidying Up Your Display

Nick Godwin

A list of numbers is conventionally written down aligned on the right. This poses a problem on the ZX81, which lines numbers up the left.

Handwritten	ZX81 display
96	96
920	920
4	4
1020	1020

A routine to print, display, and summate a series of values may look as follows:

```
110 LET T=0
120 FOR J=1 TO 10
130 INPUT A
140 LET T=T+A
150 PRINT A
160 NEXT J
170 PRINT
180 PRINT T
999 STOP
```

The problem is, how to change the ZX81 display to conform to normal convention—how to align the values to the right.

The following amendment to the above does the trick, for integers (positive or negative) only:

```
 110 LET T=0
 120 FOR J=1 TO 10
 130 INPUT A
 140 LET T=T+A
 145 LET X$=STR$ A
 150 GOSUB 1000
 160 NEXT J
 170 PRINT
 175 LET X$=STR$ T
 180 GOSUB 1000
 999 STOP
1010 PRINT TAB 17-LEN X$;X$
1020 RETURN
```

The routine prints the values neatly in the middle of the screen. However, it is very likely that you may want to print out decimal values in a similar format. The following subroutine (replacing the one above at line 1010) does the trick:

```
1010 IF X$(1)="." THEN LET X$="0
"+X$
1020 IF LEN X$>1 THEN IF X$(1 TO
 2)="-." THEN LET X$="-0"+X$(2 T
O )
1030 FOR K=1 TO LEN X$
1040 IF X$(K)="." THEN GOTO 1070
1050 NEXT K
1060 LET X$=X$+".0"
1070 PRINT TAB 17-K;X$
1080 RETURN
```

Nick Godwin, 4 Hurkur Crescent, Eyemouth, Berwickshire, Scotland TD14 5AP, United Kingdom.

To test this routine, RUN the program and enter a series of wildly different values, e.g.:

46
9.009
-34456789.98765
-0.0000002
.0000034
8.6
88888.97
9999999
.01
.09

In practice, you will be fairly unlikely to require such a wide range of values for addition purposes, but the routine works equally well for any kind of arithmetical manipulation, or for any other list of numbers.

It may well be that you require the program to add sums of money, in which case you will want displayed only the value to two decimal places (representing pence or cents). To achieve this, the routine can be amended by adding or changing the following lines:

```
 110 LET T=0
 120 FOR J=1 TO 10
 130 INPUT A
 140 LET T=T+A
 145 LET X=A
 150 GOSUB 1000
 160 NEXT J
 170 PRINT
 175 LET X=T
 180 GOSUB 1000
 999 STOP
1000 LET X$=STR$ (INT (X*100+.5)
/100)
1010 IF X$(1)="." THEN LET X$="0
"+X$
1020 IF LEN X$>1 THEN IF X$(1 TO
 2)="-." THEN LET X$="-0"+X$(2 T
O )
1030 FOR K=1 TO LEN X$
1040 IF X$(K)="." THEN GOTO 1070
1050 NEXT K
1060 LET X$=X$+".00"
1070 IF K=LEN X$-1 THEN LET X$=X
$+"0"
1080 PRINT TAB 17-K;X$
1090 RETURN
```

This routine prints the values neatly displayed in the middle of the screen, with the decimal points at TAB 16. The display routine does not affect the arithmetical calculation: you can enter as many digits as you like after the decimal point, and for the display they will be rounded to the first two decimal places. The lateral position of the display can be altered by adjusting the number (17) in line 1080, but care must be taken to allow for extra long numbers. The bug is that a value of .005 (half a pence or cent) prints as 0.00, not very serious, and probably not worth the bytes required to correct it.

The program as written occupies 394 bytes of RAM, 486 including the variables, and approximately 890 bytes including the display. Thus it is operational on 1K. The subroutine alone occupies 268 bytes. ■

8K ROM
1K RAM

Multisave

Doug Watson

Reliability of cassette storage and retrieval of programs and data requires multiple saves. Having to attend to the computer's needs as each save is completed is, however, a bit of a chore.

Wouldn't it be nice

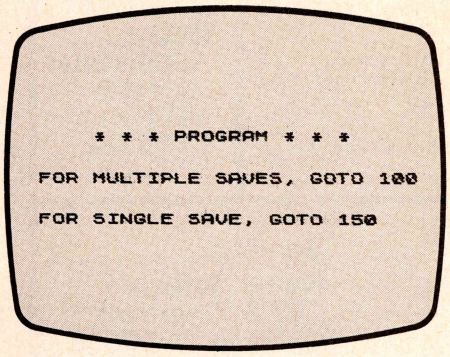
1) to key in the number of saves required and leave the ZX81 to complete that number of identical copies?

2) not have to check what variables have been assigned before incorporating this feature in a program?

3) to retain the normal, single-save mode?

If this appeals to you, try the demo program shown. The address shown as 16004 can be any unused, non-saved address in RAM (such as from 8192 to 16383 with the 64K Memopak or above RAMTOP) that is normally 0. PEEK it to find out.

```
  5 REM "PROGRAM NAME"
 10 PRINT AT 5,6;"* * * PROGRAM
* * *"
 20 PRINT "    " FOR MULTIPLE S
AVES, GOTO 100"
 30 PRINT "    " FOR SINGLE SAV
E, GOTO 150"
 40 STOP
100 PRINT "HOW MANY SAVES?"
110 PAUSE 40000
120 POKE 16507,VAL INKEY$-1
130 CLS
150 SAVE "PROGRAM NAME"
160 REM SLOW OR FAST HERE IF DE
SIRED
170 IF PEEK 16507=0 THEN RUN
180 POKE 16507,PEEK 16507-1
190 GOTO 150
```



On GOTO 100, HOW MANY SAVES? appears on the screen and waits (no L cursor). When one of the keys, 1 to 9, is pressed, the selected number of saves will be executed. If 0 is pressed, 256 saves will follow. Use BREAK to terminate.

On GOTO 150, a single save is executed.

No variables are used so compatibility with any program is automatic. ■

Doug Watson, PO Box 142, Barry's Bay, Ontario, Canada K0J 1B0.

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Making Backups for Machine Language Tapes

Jack Ryan

Not long ago I bought a cassette of utility routines for my 16K ZX81. Although the routines on the tape were just what I needed, there was one problem: the program was in machine language and once LOADed above RAMTOP it ignored my SAVE commands. If something happened to that tape I was out of luck since I had no backup — unless I could make one by some method other than SAVE.

There are two methods which can be used to make a backup.

1. Copying to a Second Tape

The first technique is to simply copy the tape onto a second tape. This requires either a tape copier or a second tape recorder.

Place the original tape in Recorder 1 and a blank tape in Recorder 2. Use one of the Sinclair recorder leads to connect the earphone (output) jack of Recorder 1 to the microphone (input) jack of Recorder 2. Set Recorder 2 to RECORD and PAUSE, and (if it has one) the automatic level control (ALC) to OFF. Set the volume controls of each recorder to midrange. Start RECORDing on the second, then PLAYing on the first. After the recording is complete, try LOADing the program as usual with your recorder. Very likely you will have to try several different volume settings on your copying set up before getting a LOADable copy. A recording level meter on Recorder 2 helps. I found that I could not get a satisfactory recording without the ALC of Recorder 2 OFF.

2. Copying with PEEK and POKE

The second technique uses the PEEK and POKE facilities of the ZX81. The program to do this is Listing 1. Like the machine language routines that you see published, the software that I purchased is LOADed into memory above RAMTOP. RAMTOP is the address of the first nonexistent byte at the upper end of memory, which means that you cannot store anything at or above it—at least that is what the computer thinks. However, the address of RAMTOP is stored in the two bytes with addresses of 16388 and 16389. You can change these two bytes with POKE, and fool the computer into thinking that some existing memory is nonexistent. This memory is hidden from Basic and so is protected for machine language use.

PRINT PEEK 16388 + 256 * PEEK will tell you the address of RAMTOP, which is normally 32768 with the 16K RAM attached. The bytes stored at 16388 and 16389 (found by PEEKing each location) are 0 and 128. Note that 0 + 256 * 128 = 32768. Before loading a machine language tape, one or both of these bytes are

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Listing 1.

```
  40 FAST
  50 PRINT TAB 7;"ML PROGRAM BAC
KUP"
  60 PRINT
  70 REM "ENTER PARAMETERS FOR Y
OUR ML PROGRAM"
  80 PRINT "ENTER THE NUMBER TO
BE POKED"
  90 PRINT TAB 10;"INTO 16388"
 100 PRINT TAB 7;"IF NONE, ENTER
0"
 110 INPUT A
 120 CLS
 130 PRINT "ENTER THE NUMBER TO
BE POKED"
 140 PRINT TAB 10;"INTO 16389"
 150 PRINT TAB 7;"IF NONE, ENTER
0"
 160 INPUT B
 170 CLS
 180 PRINT "ENTER YOUR NORMAL RA
MTOP"
 190 PRINT "(17408 FOR 1K, 32768
 FOR 16K)"
 200 INPUT R
 210 CLS
 220 REM "C = NUMBER OF BYTES PR
OTECTED"
 230 LET C=R-(A+256*B)
 240 REM "D = LAST BYTE BEFORE N
EW RAMTOP"
 250 LET D=(A+256*B)-1
 260 REM "STORE MACHINE LANGUAGE
 IN E"
 270 DIM E(C)
 280 FOR N=1 TO C
 290 LET E(N)=PEEK (D+N)
 300 NEXT N
 310 STOP
 320 REM "PUT ML ABOVE RAMTOP"
 330 FOR  N=1 TO C
 340 POKE (D+N),E(N)
 350 NEXT N
 360 STOP
 370 SAVE "P"
 380 GOTO 0330
```

changed by POKEing in new values to give RAMTOP a new, lower, address to correspond to the number of bytes required for the machine language routine. For example, the software I purchased comes with instructions to POKE 16389,124. So RAMTOP is now 0 + 256 * 124 = 31744, a difference of 32768 − 31744 = 1024 bytes. If you had a program with instructions to POKE 16388,100 and POKE 16389,125, then the new address of RAMTOP is 100 + 256 * 125 = 32100, and the number of bytes protected is 32768 − 32100 = 668.

To make a copy of your machine language software, LOAD the program according to the instructions which accompany it. Then ENTER or LOAD the program in Listing 1. RUN the program and ENTER the requested data. Because the program runs in FAST, the screen blanks out while the program PEEKs the machine code into the variable array E. When the program stops with 9/310, prepare to SAVE the program. To SAVE, enter GOTO after you have begun recording. When you LOAD this SAVEd tape (LOAD "P") after altering RAMTOP as your machine language program requires, it is self-RUNning so the screen will blank out while the code is POKEd in above RAMTOP.

If you want to SAVE a copy of Listing 1 without any machine language code so that you can LOAD it in for a variety of machine language routines, enter SAVE "P", not GOTO 370.

The program as shown in Listing 1 is meant to be self documenting and user-friendly. But this is not necessary for operation of the program. Since this probably makes the program too large for a 1K machine, and makes it take longer to LOAD in any case, you might want to shorten it a bit. You can easily calculate the new address of RAMTOP and the number of bytes protected. So you could easily eliminate all REMs and replace lines 10 through 260 with

10 FAST
20 LET C = (calculated bytes protected)
30 LET D = (calculated new RAMTOP) − 1

In summary, you can make back up tapes for machine language routines which are LOADed above RAMTOP by copying your original tape from one recorder to a tape in a second recorder, or you can use a single recorder and the Basic program in Listing 1 to PEEK out the code for SAVEing and POKE it back in when LOADing from your back-up tape. ■

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INTERP—The Kernel of Interactive Nuts

Lawrence Auer

In this article we present an easily extended, interactive interpreter, providing a stack oriented, dictionary based programming environment similar to FORTH. The interpreter is, thus, the basis for the more friendly, more interactive use of your computer. The ease with which INTERP can be coded is a dramatic demonstration of the power of the ZX81 string manipulation capabilities and the GOSUB and VAL commands.

Interaction

The essence of effective use of the personal computer is contained in the word, "interaction." While more memory and languages are desirable to have, solving problems with a computer is essentially a function of how easy it is to control the machine. A computer is able to perform simple tasks like adding one and one, or recalling what the balance is in the checking account, or integrating a set of differential equations. What it has trouble with, and what humans excel at, is decision making and recognition of the significance of a result. (Computers are just as happy with a balance of -$1.00 as +$100,000.00) Thus, a proper man-machine dialogue might have the form:

Man: What would happen if ....?

Machine: !!!!!!! (a result unexpected or undesired by Man)

Man: Well then, do this first: .....

Man: And then, do this: ....

Machine: ..... Hmmm

Man: Given that, what would the further consequences be?

Machine: .....

Man: Thanks.

Any program which inputs data and permits decisions on the basis of the input is, of course, interactive. The operationally important point is that in normal programs, the control is quite limited. The flow of code is restricted. Control cannot be arbitrarily transferred from one place in a program to another. Humans do not normally suffer from this restriction. They can do their operations in whatever order is most convenient. The purpose of INTERP is to provide the basis of a "General Interactive System" of maximal flexibility.

The features required in an interactive system can be seen in the following simple example. Consider a program to keep track of where you are spending your money. Inputs to your program are the amount and the type of each expenditure. We leave the details of the coding as a problem for the reader, but a typical interactive session with a program based on INTERP could be

```
?
225.00 RENT
42.27 FOOD
9.25 CLOTHING
2*0.90 3*0.65 + 0.45 + , FOOD
EXPENDITURES
CLS
... more entries ...
EXPENDITURES
STOP
```

The general features and requirements demonstrated by this example are as follows:

1) The interactive system is composed of individual modules or "primitive operations." In the above example, "EXPENDITURES", lists the totals so far in each category, while "RENT" adds the amount indicated to the category rent. Each module has a well-defined input and output. They share data but their actions are accomplished by separate pieces of code.

2) Except for obvious dependencies like initialization, the order in which the modules may be invoked is arbitrary.

3) The simplest way to call up a module is by name. It is both more easily remembered and more reliable to use "RENT" than to choose this operation by number from a menu, which is the typical method employed.

4) There must be a general way of passing values or "arguments" to and from the modules. The result of an operation need not be printed, but it should be easily available. In other words, we want the equivalent of "named subroutines".

5) Modules like "RENT" or "FOOD" are obviously problem specific, but some operations are of such general utility that they will be needed in most programs. The general purpose modules which are built into INTERP are:

?	—Output the names of the modules defined in the dictionary.
,	—Output the value at the top of the stack (see below for a discussion of stacks).
.	—Output the top element, then remove it from the stack.
Stop	—Stop the program (SHIFT A), CONT will restart with no loss of results.
CLS	—Clear the screen; note this is the three letters C L S.

All Basic functions, e.g., RND or PI any variable used in the Basic code, e.g., S or D, or any arithmetic operator, e.g., ** or /, are legal and usable.

Basis of INTERP

The key element of our implementation of these ideas in INTERP will be the use of BASIC SUBROUTINES. A subroutine is simply a block of code which is called via the GOSUB command. Control is transferred to the line number given in the GOSUB call, as in a simple GOTO. The important difference is that subroutines remember from where they were called. When a RETURN command is

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encountered control returns to the line following the GOSUB which invoked the subroutine. Conceptually, a GOSUB command amounts to telling the program to "go perform a series of commands and then come back when you are done with them." This is exactly what we want for a module.

For anyone accustomed to programming in languages such as Pascal or Fortran, the most fundamental deficiency in the ZX81 Basic is that subroutines are not named. While GOSUB 700, for example, can be executed interactively and may cause the data to be plotted, humans are more at ease with typing "PLOT" in order to accomplish that task. We clearly cannot change the definition of the Basic language, but what we can do is make it easier for a user to get at pieces of the code. That is, through INTERP we add another level of code which "interprets" the input. Via INTERP we expand the Basic vocabulary so it includes whatever operations we require.

The basis of the ability of INTERP to provide named subroutines is its dictionary, which consists of the names of the routines, stored in the string array, D$, and the definitions, which are nothing more than the line numbers with which the Basic subroutines start, stored in the array, D, in the same order as the words in D$. Because the order is the same, the elements of the two arrays are related when they have the same subscript. For example, D$(3) is the name of the third module, while D(3) is the line number where the third module starts. INTERP determines the meaning of an input word, W$, by scanning through the dictionary looking for the value of the subscript, J, for which W$=D$(J). Once the subscript is known, GOSUB D(J), executes the indicated subroutine. In other words, the dictionary gives a name to a line number. Of course, the block of code starting there must be a true subroutine, i.e., terminated by RETURN.

Central to the operation of INTERP is the concept of a "stack," which is just the mathematical analogue of a pile of dishes on a spring-loaded dispenser at a cafeteria. Put a dish on the stack, and it "pushes" the stack of dishes down one level. Take a dish off, and it "pops" the stack up one level. The mathematical stack is just an array of numbers with a pointer to the location of the current "top of the stack." The basic rule in "stack processing" is that an operator always works on the elements at the top of the stack. The stack provides the logical organization for performing a series of operations. Say we want to evaluate

ERFC (FUNC(PI+7))

In our stack system we would re-write this as

PI 7☆FUNC ERFC

The PI and 7 are values placed on the stack. The + removes the two top stack elements, adds them, and puts the result back on the stack. FUNC and ERFC simply get their one argument from the stack and replace it with the appropriate result, ready for the next operation.

An operation always consists of removing the arguments used by the function from the top of the stack and leaving the result generated as the new top value. While the standard mathematical operators have either one or two arguments and return one value, user-defined functions may have as many arguments as needed and return an arbitrary number, up to the limit defined by the size of the stack.

Implementation of INTERP

Our interpreter consists of the following steps:

1) Get a word of input (GOSUB 200)

2) Is the word in the dictionary?
IF W$=D$(J) THEN GOSUB D(J)

3) If not found, then:

If the word is a Basic operator, apply it to the stack.

Otherwise apply VAL to it and put the result on the stack.

4) Go back to (1) for more words.

This is a fully general interpreter. As a side benefit, it is also a "Reverse Polish Computer" which can be used in the same way as an HP calculator.

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While one could require that each word be terminated by NEWLINE, it is much more friendly to permit "type ahead," that is, to allow the input to be as long a string as the user wishes. Words are then extracted from the input string by using internal spaces as delimiters. This is particularly convenient, since we permit arguments to be associated with subroutine calls. For example,

```
3 ERFC.
```

is easier to type and understand than the totally equivalent,

```
3
ERFC
```

When the input line has been completely processed, INTERP prompts for further input by printing, "OK".

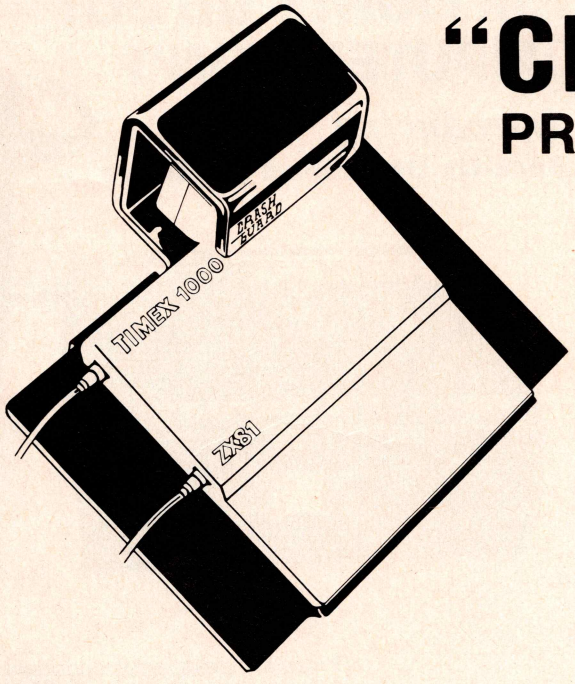
The division of the line into words is done in the code starting at line 240. Note that the code starting at line 300 "hashes' " the word being input. This hashing technique only affects words which are longer than four characters. It is done so that words of any length may be put in the dictionary without having to pay too high a storage cost. When strings are dimensioned, say DIM D$(20,4), the maximum number of characters in each D$(I) is the second value in the DIM statement. Thus, one could never store the string, "SOLVE", in this array. LET D$(1) ="SOLVE" is legal, but results in D$(1) containing only "SOLV". Thus, we hash the word by storing its first four characters, and then changing the fourth character to be the length of the word if it is longer than four characters. The effect is to reduce the length of all words to just four bytes, but to maintain distinction among them. For example, "SOLVE" becomes "SOL5", while "SOLVENT" becomes "SOL7". This hashing scheme must be recognized when extensions are made to the dictionary. The word, "SOLVE", is made the seventh word on the dictionary by adding before line 90, LET D$(7)="SOL5" and changing the value of D, set in line 90, accordingly.

Note, how we use the CHR$ function in line 310 to generate the character corresponding to a numerical value. Since "O" is the 28th character in the ZX81 character set and the digits are stored in ascending order, CHR$(28+N) generates the symbol corresponding to the number N. If N=10, 11, ..., the characters generated by this algorithm are "A", "B", ...

The code starting at line 500 is used to evaluate expressions and is based on the extremely powerful ZX81 function, VAL. This operator, when applied to an arbitrary string, produces the numeric value defined by the string. For example, if the Basic variable X=O, the expression VAL "COS X" has the value 1. VAL permits the input to contain any BASIC expression which does not contain an explicit space. Expressions may also be entered in the "Reverse Polish Notation" natural to INTERP, although then each operator and term must be delimited by spaces. The point is that the type ahead feature uses spaces as delimiters. "2**3", for example, which contains no spaces, is treated as a single expression. Since it is not found in the dictionary or recognized as an operator, it is evaluated by VAL and the result, 8, put on the stack. The input, "2 3 **", where the symbols are separated by spaces, is split and each term treated separately. The "2" and "3" are individually evaluated by VAL and the corresponding numerical values put on the stack. Then INTERP recognizes "**" as a binary operator and, as described below, creates a string and then applies VAL to it the top two elements of the stack, replacing them with 8.

Strings containing operators are easily created. Almost every symbol appearing on the keyboard, with the exception of keywords like PLOT, UNPLOT, etc., which are white and above the keys, can be entered by a single keystroke. Thus, to enter the word STOP one needs only type SHIFT A; a call for the SIN operator is FUNCTION Q, and so on. Note, that even though the ZX81, when it prints these words, adds spaces of its own, they must be delimited by true spaces when being input to INTERP.

The hashed input word is compared with the dictionary in the loop starting at line 410. If it is found, the corresponding subroutine is



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executed. If not found, at line 500 it is checked to see whether the unknown word is actually a Basic operator. Finally, if still unrecognized, INTERP concludes that the word must actually be a Basic expression and goes to line 600 to evaluate it. The result produced by VAL is stored in the stack vector, S. If a typing error was made, the word entered will be meaningless to INTERP and an error will be signaled. If this happens, the user can continue without any loss of the computations already made by entering GOTO 100.

In order to apply W$ as a Basic operator, we must make one further judgment: is W$ a binary operator, like +, or a unary operator, like SIN? This is decided in line 510. The expression to be evaluated is constructed by string concatenation in lines 550 (binary operators) and 570 (unary operators). The values used are replaced on the stack by the value generated. We see here how by using VAL and string manipulation one can create at run time the equivalent of Basic program statements.

The stack in INTERP has been implemented using the array S(). The pointer to the top is the value of variable S. The top value on the stack is, therefore, S(S). Whenever the stack is manipulated, the value of S must be changed accordingly. For example, when one does a binary operation, as in lines 540-550, S is reduced by one. Any user subroutine which requires arguments should check that there actually are as many elements on the stack as will be needed. If S is less than the number that are needed, GOTO 9990 will generate an appropriate error response.

Simple Example: A Reverse Polish Calculator

As an example of how one adds new routines, let us produce a program which models a simple HP-like calculator. Because calculators are clearly interactive, INTERP is our natural starting point. We already have all the mathematical functions, so in order to create our calculator program, all we will need to add are a few operations for manipulating the stack:

DUP —Duplicate the tope element, i.e., push this value again onto the stack.

SWAP —Interchange the top and next elements on the stack.

ROTATE —Rotate the order of the stack elements.

STACK —List the values on this stack, top first.

The code for including these four new words is given in the second listing. The important points to note are:

1) The new definitions in the dictionary must be made before line 100, the start of the interpreter.

2) If a name is longer than four letters, like ROTATE, it is stored in D$ by its first three letters followed by its length, "ROT6".

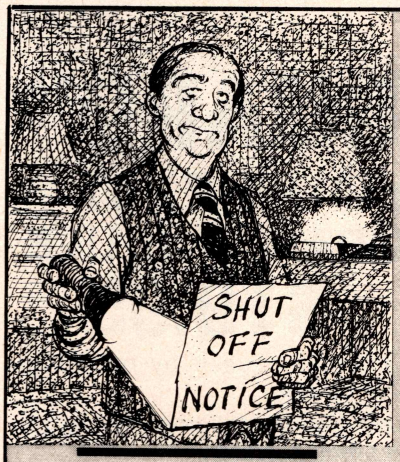
3) Each subroutine must be terminated by a RETURN.

4) Routines should check that there are an adequate number of arguments on the stack. If there are not, the transfer GOTO 9990 will indicate the error.

If you are not familiar with the reverse Polish system used on HP calculators and in INTERP, it would pay you to enter the statements of the second listing and then to try it. One very important thing to note is INTERP DOES NOT AUTOMATICALLY OUTPUT ANY RESULTS. In order to see the result of a calculation you must use either the command, ",", which will print the answer, or ".", which prints and then discards the top of the stack. Typical calculations would be found in figure 1.

Figure 1.

```
3 DUP * 4 DUP * + = SQR.      equivalent to PRINT SQR(3*3*=4*4)
1 2 / , 1 SWAP / .            will print .5 and 2
1 2 3 4 * * * .               equivalent to PRINT 1*2*3*4
STOP
```

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Remember, the words and numbers can be entered using as many lines as you wish.

In passing, we should note that, while INTERP permits arbitrary length words, your fingers may not appreciate this. Thus, you will probably want to use "ROT" instead of "ROTATE". To be entirely general, you can include both forms in the dictionary as there is no requirement that a given Basic module have a unique name.

General Use of INTERP

In itself, INTERP solves no problem; it only provides a framework which can be used to ensure that the code will be simple to use. The steps that should be taken in employing INTERP are:

1) Enter and save the basic INTERP program given in Listing 1.

2) Whenever you wish to create a program, LOAD INTERP.

3) Modify it, coding the various Basic routines you need. Terminate each by RETURN and make sure it properly adjusts S.

4) Extend the dictionary, by adding new values to D$() and defining D() accordingly. The variable D, defined in line 90, is the length of the dictionary.

5) SAVE your new program. The important point is that, although the code in Listing 1 is long, it need only be entered once. After it has been stored on tape, it can be loaded and the needed routines easily added.

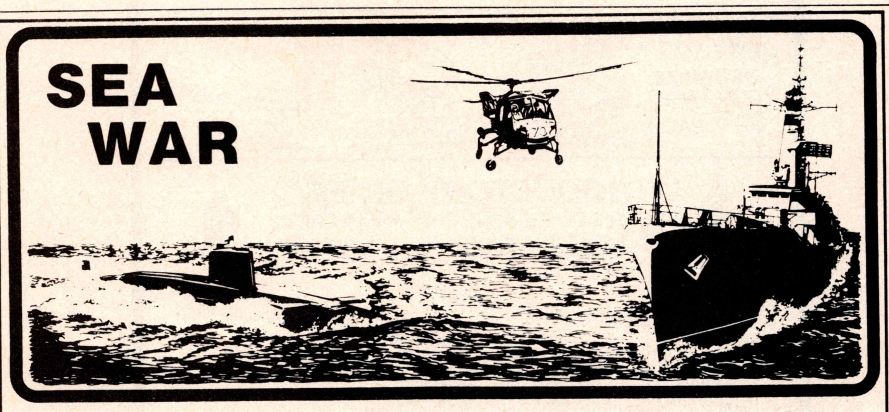
We hope that you, too, find that INTERP is the best starting point for the creation of interactive programs. As it is a different approach from the typical one, at first, coding may feel strange, but the ease of its use will justify the learning experience. ■

Listing 1. INTERP.

```
   1 REM INTERP
   2 LET S=0
   3 REM MAX STACK DEPTH IS 10
   4 DIM S(10)
   5 REM TO MAKE DICTIONARY SIZE
>10  REDIMENSION D$ AND D
   6 DIM D$(10,4)
   7 DIM D(10)
  10 LET D$(1)=","
  11 LET D(1)=1530
  12 LET D$(2)="."
  13 LET D(2)=1505
  14 LET D$(3)="CLS"
  15 LET D(3)=1510
  16 LET D$(4)="?"
  17 LET D(4)=1525
  20 REM INCLUDE USER DEFINITION
S HERE
  89 REM D IS NUMBER OF WORDS IN
 DICT
  90 LET D=5
  91 LET D$(D)=" STOP "
  92 LET D(D)=1500
  98 LET L$=""
  99 REM INTERPRETER
 100 GOSUB 200
 110 GOSUB 400
 120 GOTO 100
 199 REM WORD
 200 IF L$<>"" THEN GOTO 240
 210 PRINT "OK "
 220 INPUT L$
 230 PRINT L$
 240 FOR L=1 TO LEN L$
 250 IF L$(L)<>" " THEN NEXT L
 260 LET W$=L$( TO L-1)
 270 LET L$=L$(L+1 TO )
 280 IF W$="" OR W$=" " THEN GOT
O 200
 290 RETURN
 299 REM HASH
 300 LET H$=(W$+"    ")( TO 4)
 310 IF LEN W$>4 THEN LET H$(4)=
CHR$ (28+LEN W$)
 320 RETURN
 399 REM SEARCH DICTIONARY
 400 GOSUB 300
 410 FOR J=1 TO D
 420 IF H$=D$(J) THEN GOTO 650
 430 NEXT J
 499 REM OPERATOR
 500 IF LEN W$>1 OR W$<">" OR W$
>"<" OR W$<"SIN " AND W$>"/" TH
EN GOTO 600
 510 IF W$>"/" AND W$<"**" THEN
GOTO 570
 520 REM BINARY OPERATOR
 530 IF S<2 THEN GOTO 9990
 540 LET S=S-1
 550 LET S(S)=VAL ("S(S)"+W$+"S(
S+1)")
 560 RETURN
 569 REM UNARY OPERATOR
 570 LET S(S)=VAL (W$+"S(S)")
 580 RETURN
 599 REM VALUE
 600 LET S=S+1
 610 LET S(S)=VAL W$
 620 RETURN
 649 REM GOSUB BASIC SUBROUTINE
 650 GOSUB D(J)
 660 RETURN
1499 REM STOP . CLS ? ,
1500 STOP
1501 RETURN
1505 IF S<1 THEN GOTO 9990
1506 PRINT S(S)
1507 LET S=S-1
1508 RETURN
1510 CLS
1511 RETURN
1525 PRINT "COMMANDS"
1526 FOR I=1 TO D
1527 PRINT D$(I)
1528 NEXT I
1529 RETURN
1530 IF S>0 THEN PRINT S(S)
1531 RETURN
9989 REM ERROR DETECTED
9990 PRINT "? ";W$
9991 RETURN
```

Listing 2. RPN Calculator.

```
   1 REM RPN CALCULATOR
  50 REM DEFINITIONS
  51 LET D$(5)="DUP"
  52 LET D(5)=5000
  53 LET D$(6)="SWAP"
  54 LET D(6)=5100
  55 LET D$(7)="ROT6"
  56 LET D(7)=5200
  57 LET D$(8)="STAS"
  58 LET D(8)=5300
  90 LET D=9
4999 REM DUP
5000 IF S<1 THEN GOTO 9990
5010 LET S=S+1
5020 LET S(S)=S(S-1)
5030 RETURN
5099 REM SWAP
5100 IF S<2 THEN GOTO 9990
5110 LET TMP=S(S)
5120 LET S(S)=S(S-1)
5130 LET S(S-1)=TMP
5140 RETURN
5199 REM ROTATE
5200 IF S<2 THEN RETURN
5210 LET TMP=S(S)
5220 FOR I=S TO 2 STEP -1
5230 LET S(I)=S(I-1)
5240 NEXT I
5250 LET S(1)=TMP
5260 RETURN
5299 REM STACK
5300 FOR I=S TO 1 STEP -1
5310 PRINT S(I);" ";
5320 NEXT I
5330 PRINT
5340 RETURN
```

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The features which appear on the screen are as follows:
Submarine, Warship, U-boat and Helicopter.

Submarine

This feature is under your own control and is loaded at the left hand side of the screen. The keys '9' and '0' are the firing buttons for the upward missiles and forward missiles respectively.

The submarine can be moved in four directions; it can move upwards and downwards by pressing keys '7' and '6' respectively. In order to move forward, you press key '8' and it will draw back to its previous position when you release the button. Also, the submarine can be moved diagonally upwards or downwards by pressing both keys '8' and '7' or keys '8' and '6' respectively at the same time.

U-boat

This is the hostile submarine: It drifts under the sea level randomly, from right to left. Missiles are fired as it approaches your submarine. Destroying a U-boat scores 20 points.

Warship

This is the enemy destroyer which will release bombs diagonally as it drifts on the sea surface from right to left.

The destruction of a warship is done by either firing a vertical missile or, when the submarine is just under sea level, by pressing keys '7' and '0' which release a horizontal missile. Otherwise the missiles will just pass under the ship bottom. Each destruction of this feature scores 50 points.

Helicopter

As you reach a certain score, helicopters appear on the left hand corner of the screen; they drop vertical bombs as they hover above the submarine. To destroy the helicopters, vertical missiles can be fired by pressing key '9'. Each helicopter destroyed scores 100 points.

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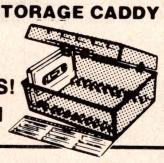

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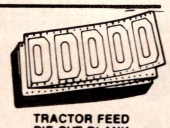

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The Unprintable Characters

Michael W. Schultz

The purpose of this article is to illustrate the power of the CHR$ function. The argument for the CHR$ function is a numeric value code from 0 to 255. This is the entire character set of single letter characters, keywords, and tokens. Refer at this point to the character set listing in the appendix of your programming manual. You will see that character codes 67-111, 122-125, and 195 are not used in the ZX81 system. You can verify this by running the program in Figure 1. The unused codes are shown as question marks.

Figure 1.

```
10 FOR N=0 TO 255
20 PRINT CHR$ N;
30 NEXT N
```

Now change line 10 to 10 FOR N= 128 to 191 and hit RUN then ENTER. The characters displayed cannot be entered from the keyboard itself. The interesting thing about this concept is that graphic strings are printed very rapidly and this may be applied to any work dealing with high speed graphics.

The CHR$ function can also be used to compare other nonprintable functions such as the cursor operation symbols like "▲"; "▼"; "◀"; "▶"; which cannot be placed onto the screen. This is accomplished by applying a string equivalent, which can be called by using their respective CHR$ codes (112-115). We can examine an example of that code by using the CHR$ (114) for the backspace cursor in Figure 2. Type in Figure 2 at this point.

Figure 2.

```
 10 LET A$=INKEY$
 20 IF A$="" THEN GOTO 10
 30 IF A$<>CHR$ 114 THEN GOTO 7
0
 40 SCROLL
 50 PRINT "LEFT CURSOR ON"
 60 GOTO 10
 70 SCROLL
 80 PRINT A$
 90 GOTO 10
```

In the SLOW mode hit RUN then ENTER. What happens when you depress SHIFT then hit 5? Try the other SHIFTed cursor positions. Experiment with ENTER and other keyboard letters, numbers, and tokens. Hit BREAK to STOP the program when you are finished. ■

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Programming the LOAD Command

Michael J. Gentilcore

Do you have some machine code programs stored on tape that require POKEing RAMTOP before LOADing the program from cassette? Or are you writing your Basic programs around a favorite machine code POKEing routine? If so, knowing how to program the LOAD command can be a real convenience.

Using the LOAD command in a program allows you to read and execute a series of programs on tape without the hassle of starting and stopping the cassette deck. The first program can change RAMTOP in preparation for a machine code POKEing program. The next program(s) can POKE in your USR routine(s) above RAMTOP. The last program can be a basic program that uses the USR routines.

To illustrate how this works in practice, the LSCROLL program written by Douglas D. Sharp will be used (*SYNC* 2:2).

Listing 1 is a program to change RAMTOP. Type in this program. To store this program on tape, you need to be able to distinguish between the LOAD and SAVE modes by looking at the TV display. If you are unfamiliar with the LOAD pattern, type RUN and ENTER to observe the LOAD pattern. Hit the BREAK key to exit the LOAD mode. When you know what the LOAD pattern looks like, you are ready to store this program on tape. Use the following procedure:

1) Press CLEAR and ENTER, RUN 500 and ENTER, and start your cassette deck in record mode.

2) Observe the SAVE pattern on the TV display.

Michael J. Gentilcore, 503 Cannonbury, Webster Groves, MO 63119.

Listing 1. RAMTOP Change.

```
10 POKE 16388,68
20 POKE 16389,127
30 LOAD "LSCROLL"
40 STOP
50 SAVE "TEST LSCROLL"
60 GOTO 10
```

Listing 2. LSCROLL.

```
  4 LET C=0
  5 REM ALL OS IN THIS LISTING
  6 REM ARE ZEROS.
 10 LET D$="3AEE7FFE16DA517F3EO
032EE7F3AEF7FD600CA617FFE15D2617
FC3667F3E1632EF7FF53AEF7F47F13AE
E7F80FE16DA857F26002E163AEE7F4FO
600ED427D32EF7FED5BOC400EFFF53AE
E7F6FF126000600lAFE76CA9F7F13C39
57FOCA7E5ED42E1CAAC7F13C3957FO60
OF53AEF7F4FF1C5D5E1237EFE76C2B77
FE5A7ED522B7D4DD600E1C2DO7FE5D1C
3E57F3DC2D87F13C3E17FO6000B13D5E
123EDBO3EOO1213C10B79D600C2B47FC
90000"
 20 FOR X=2 TO 344 STEP 2
 30 LET P=(CODE D$(X-1)-28)*16
 40 LET P=P+CODE D$(X)-28
 50 POKE 32579+INT (X/2),P
 60 LET C=C+P
 70 NEXT X
 80 PRINT C
```


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3) Stop the cassette deck when the LOAD pattern appears.

4) Hit the BREAK key to exit the LOAD mode.

Listing 2 is the program for LSCROLL. Some readers will already have it on tape. For those who do not, carefully type in the program and RUN it. If, within a few seconds, the number 22093 appears on your screen, you have correctly entered the program.

Modify the LSCROLL program by typing in the additional statements in Listing 3. SAVE the program on tape directly after the first program. Use the same procedure as before—except substitute the command RUN 100 for RUN 50.

Did you notice the screen go blank before the LOAD pattern appeared? The program was executing during this time.

Type NEW and ENTER to erase the LSCROLL listing.

Now type in the program in Listing 4. Save this program after the second program. Use the command

SAVE "TEST LSCROLL" and ENTER

This program is being SAVEd in the standard fashion under the name "TEST LSCROLL".

Now it is time for the acid test. Rewind your cassette deck into position to LOAD the first program. You should be able to LOAD and execute all three programs in a single loading. Let's go:

1) Type LOAD "TEST LSCROLL" and ENTER.

2) Start the cassette deck.

3) Observe your TV display.

Listing 3. Additional Statements.

```
 80 LOAD "TEST LSCROLL"
 90 STOP
100 SAVE "LSCROLL"
110 GOTO 4
```

Listing 4. Test LSCROLL.

```
 10 PRINT AT 0,13;"TEST";AT 5,1
3;"HELLO";AT 20,13;"GOODBYE"
 20 POKE 32750,2
 30 POKE 32751,20
 40 PAUSE 20
 50 RAND USR 32580
 60 GOTO 40
```

You should be able to distinguish the following phrases:

a) LOAD pattern.

b) Read pattern for the first program.

c) LOAD pattern.

d) Read pattern for the second program.

e) Execution of the second program (blank screen).

f) LOAD pattern.

g) Read pattern for the last program.

Continuing with the sequence,

4) Screen returns

5) Stop cassette deck

6) Type RUN and ENTER

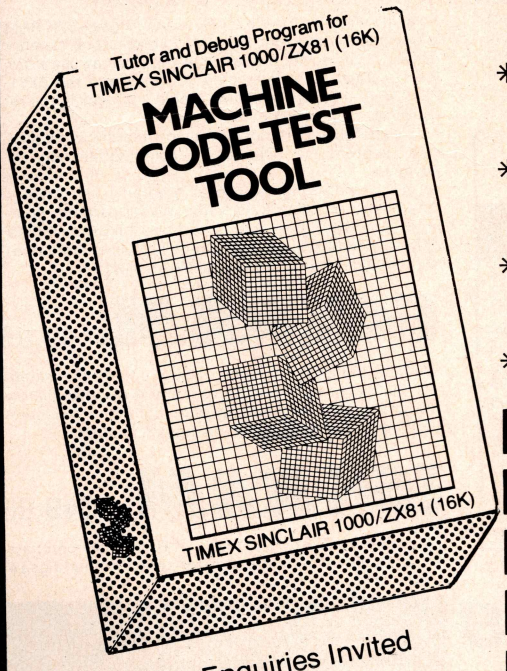
Super! A single LOADing has changed RAMTOP, POKEd in a USR routine, and read in your Basic program. Only the program of interest is stored in memory. It is almost as good as buying a ROM that has your favorite USR routines on it.

A couple of questions for the reader to enjoy:

1) How could you modify the last program so that it runs itself after loading?

2) What do you think would happen if the BREAK key is pressed during the LOAD cycle during the phases that are asterisked?

At Last Your Chance To Crack The Machine Code



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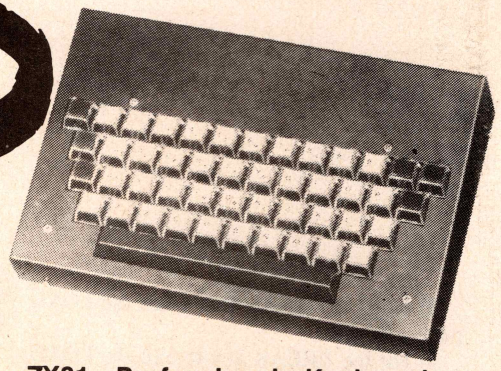

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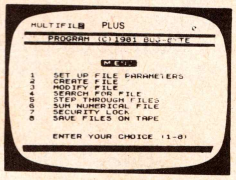

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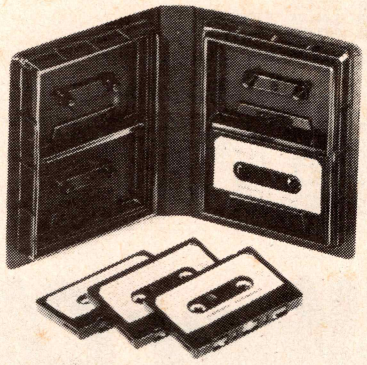

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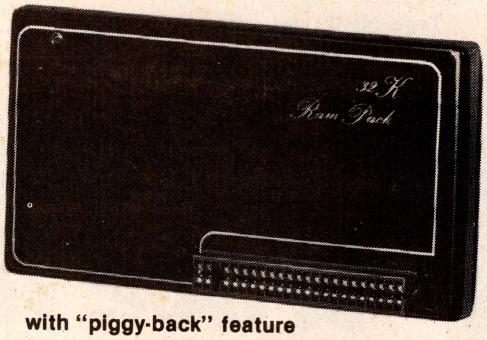

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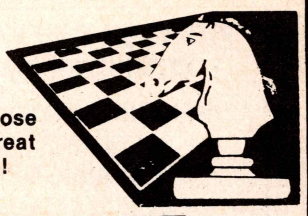

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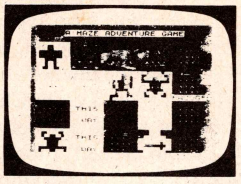

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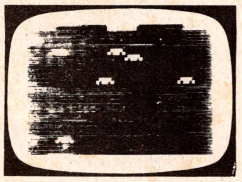

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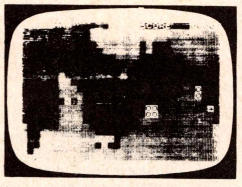

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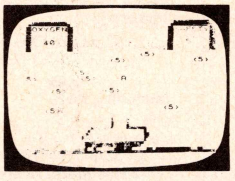

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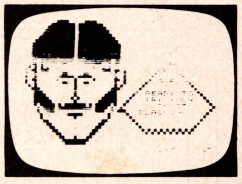

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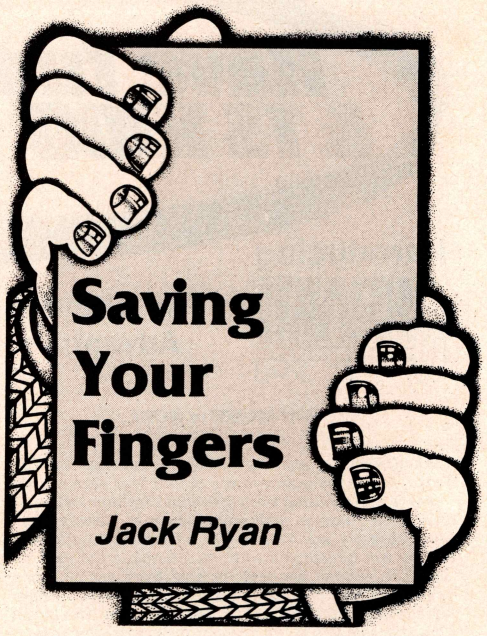

Occasionally a program has lines which are almost identical usually because of conditional statements. For example:

```
 320 IF A$(6 TO 14)="NOTAFRAID"
THEN PRINT "OH OH ";N$
 330 IF A$(6 TO 14)="NOTAFRAID"
THEN PRINT "YOU FORGOT A SPACE A
TER NOT"
 340 IF A$(6 TO 14)="NOTAFRAID"
THEN PRINT "TRY IT AGAIN"
 350 IF A$(6 TO 14)="NOTAFRAID"
THEN GOTO 250
Or:
 360 IF A$(6 TO 14)<>"NOTAFRAID"
 AND A$<>"I AM NOT AFRAID OF COM
PUTERS" THEN PRINT "SOMETHING IS
";B$;"WRONG. TRY IT AGAIN"
 370 IF A$(6 TO 14)<>"NOTAFRAID"
 AND A$<>"I AM NOT AFRAID OF COM
PUTERS" THEN GOTO 250
(B$ is either a space or the
word "STILL".)
```

Such lines quickly become a pain to the fingertips, but there is an easy way to avoid these agonies by using the EDIT function.

When you have typed and ENTERed the first line of the series with similar lines, hit EDIT and the line will be brought back to the bottom of the screen. Change the line number to the next line number needed and move the cursor to the end of the line. Then, using DELETE, remove everything that is not needed for that line.

Now add the new material and ENTER the line. Repeat the process for as many lines as needed using the EDIT key to bring down the line that is closest in content to the next line you want to type in. You may even want to plan your program so that you can take advantage of this technique from the beginning.

The procedure saves time and avoids the tedium of entering the same thing over and over and . . . ■

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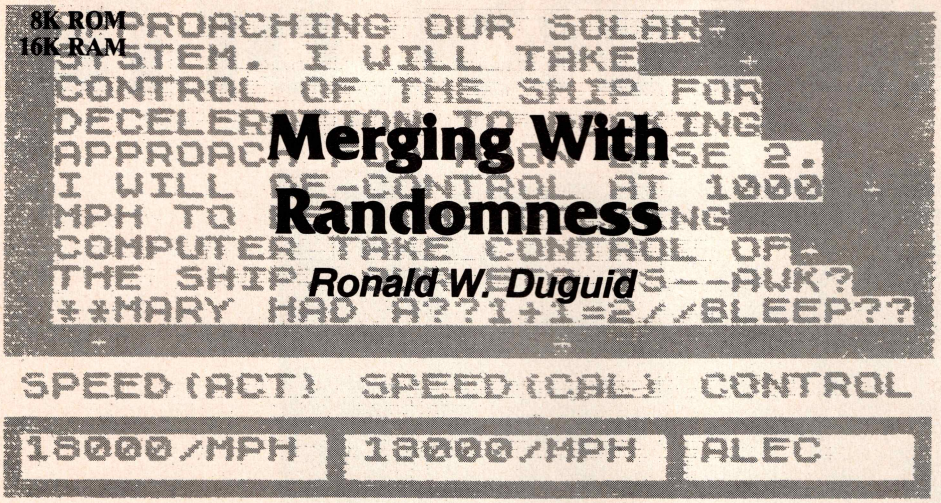
Merging With Randomness

Ronald W. Duguid



There is a precept in the Buddhist philosophy which states that for a person to truly understand any thing, the person must merge with that thing and become one with it. I have not reached the state where I can merge with anything, let alone an abstract concept such as "randomness," but I was reminded of this precept when I tried to apply the RND function to a program that I was developing.

The program was in the form of a quiz game, and I wanted to use the RND function to select the questions. I had chosen to go this way so that the questions would not appear in sequence. This would prevent the player from memorizing the answers in sequence. Never knowing which question would be coming up next, the player would have to think in terms of relating the answer to the question. He would not be able to respond in the manner: The answer to question number 5 is apples; the answer to question number 6 is beans, etc.

I was using a random statement in the form:

10 LET A=INT(RND*10)+1

which allowed me to select randomly from a set of ten questions.

This seemed to work well with one exception. Every so often, the same question would immediately repeat. So I pressed a friend into service as an objective player to help me debug the program. After the same question had repeated several times in a row, he turned to me with a raised eyebrow and asked, dryly, "What's the matter—is it broken?"

I realized that I had a situation that could cause some embarrassment, so I decided to dig deeper into the RND function to see if there was anything that could be done to solve the problem.

The RND Function

Obviously the starting point was to get out the ZX81 handbook and look up the RND function.

Ronald W. Duguid, 4352 Grow Road, NW, Stanton, MI 48888.

Then I began to experiment with the RND function by using the program:

```
10 FOR C=1 TO 10
20 LET A=INT(RND*10)+1
30 PRINT C;".#";A
40 NEXT C
50 STOP
```

This program selects a number between 1 and 10 and prints it. Several test runs are shown below (read down):

1.	8	7	1
2.	10	1	2
3.	2	1	6
4.	2	8	6
5.	2	4	7
6.	1	4	4
7.	10	10	5
8.	7	7	5
9.	2	10	10
10.	4	3	2

This was definitely not what I wanted.

The handbook says that the RND function is not truly random, but is pseudo-random, being based on a fixed sequence of 65536 numbers. The RND function has a control called RAND which, when followed by a number other than 0, will cause the RND function to start at the same point each time the RND statement is executed. If RAND is followed by 0 (or no number, at all), then the RND function is controlled by a variable called FRAMES.

An initial control number, which is another variable appropriately called SEED, is used to generate the RND number. SEED is controlled by both RAND and FRAMES. So the next step was to dig deeper by examining FRAMES, SEED, and RAND.

FRAMES

FRAMES acts like a 16 bit down counter which is located at addresses 16436 and 16437. Address 16436 contains the LSB (least significant byte) of the count number, and address 16437 contains the MSB (most significant byte) of the count number.

The count begins at 65536 and counts down to 0. When it reaches 0, it resets to 65536 and starts to count back to 0 again. FRAMES can be PEEKed by using the program in Listing 1. It will sample the FRAMES counter (both bytes), and then print out the value. SAVE this program. It can be used later in the article.

Each time you run this program, you will get a different series of numbers because the FRAMES counter is continuously counting. If you add the following statements:

```
25 POKE 16437,0
27 POKE 16436,0
```

you will cause the FRAMES counter to reset to 0 at the start of every run, and the next number will always be 65531.

The FRAMES counter is also used by PAUSE. When PAUSE is executed, bit 15 of the FRAMES counter is set to 0 and the time of the pause is entered into the FRAMES counter. The FRAMES counter then counts down from this value to 0. FRAMES is clocked at the rate of approximately 60 counts per second, so a PAUSE 60 will cause the program to pause for approximately 1 second. With bit 15 being set to 0, the maximum count (2**15-1) for PAUSE is 32767. At 60 counts per second, this amounts to a little over 9 minutes at the maximum count. The pulse that causes FRAMES to decrement (count down) comes from the computer sync generator that controls the vertical sweep of the TV set that is being used as a video monitor.

Listing 1. RANDOM.

```
  10 REM "RANDOM"
  20 DIM A(20)
  30 FOR N=1 TO 20
  40 LET A(N)=PEEK 16436+256*PE
K 16437
  50 NEXT N
  60 FOR M=1 TO 20
 150 PRINT AT M,1;M;". ";A(M)
 160 NEXT M

  25 POKE 16437,0
  27 POKE 16436,0
```

SEED

SEED also acts like a 16 bit down counter. It occupies the two memory locations with addresses 16434 and 16435. Like FRAMES, the lower number address contains the LSB and the higher address contains the MSB of the count number. Since each memory location can hold only an 8 bit number, two locations are needed for the 16 bit numbers of FRAMES and SEED.

SEED can also be PEEKed. Change Listing 1 as follows:

LET A(N)=PEEK 16434+256*PEEK 16435

Add:

45 RAND 0

If the RAND statement is not added, SEED will not start decrementing.

SEED does not act quite like FRAMES. The first count will be the last count recorded in any previous run. This seems to indicate that SEED is not counting continuously, but is switched on and off by the RAND statement.

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SEED can be POKEd by using lines 25 and 27 given above, as was done with FRAMES. The first count will be 0, but the next count begins with the current count in FRAMES. SEED does not start at 65531 after being POKEd to 0.

Both SEED and FRAMES are SAVEd when you SAVE a program on tape. The numbers are re-enteered on LOAD, and the new count is started with these values.

RAND

RAND is used as a control for SEED. If RAND is given the value of 0, then SEED will take on the decrementing values of the FRAMES counter. If RAND is given any number from 1 to 65535, then SEED takes this value only. The output number from RND will always have the same value, no matter how many times it is run. You can test the effect of values of RAND other than 0 by using the same program that was used for SEED. Just change the value for RAND in line 45. For example: 45 RAND 100; 45 RAND 250; etc. You will see that SEED will always have the RAND value in it.

The Mersenne Prime

As I continued to probe deeper into the subject of RND, I evenually came to the information entitled,"For mathematicians only." I read through this quickly, until I came to the statement, "65537 is a Mersenne prime, 2**16-1." Wait a minute —not on my calculator!

My curiosity aroused, I pursued this further and discovered that 65537 is not a Mersenne prime at all. It is instead a Fermat prime based on Pierre De Fermat's equation:

$$F_n = 2^{2^n} + 1$$

for n = 1, 2, 3,..., (try n = 4). De Fermat and Mersenne, at the same time (early 17th Century), were both trying to establish a method of solving for prime numbers. De Fermat's effort (one of many in the field of mathematics) is expressed in the equation previously mentioned. Mersenne's equation

$$M_p = 2^p - 1$$

(where p is any prime) has been found flawed, and is no longer considered valid.

At that point, I prudently withdrew. Perhaps someone with greater mathematical expertise than I will clear this matter up.

The Revelation

After looking through the explanations for RND and its accessory controls, I had not found any way to solve my initial problem. Then, in a flash of insight (perhaps another Buddhist principle was at work here: "enlightenment") I saw what I should have seen before: *One of the properties of "randomness" is that the same event can immediately repeat one or more times.*

This meant that there was no solution to my problem within the RND function.

An External Solution

Once I realized that I could not alter the RND function, I started looking for other ways to go. Listing 2 was the result.

Listing 2. Inhibiting the RND Function.

```
10 LET B=0
20 FOR C=1 TO 10
30 LET A=INT (RND*10)+1
40 IF A=B THEN GOTO 30
50 LET B=A
60 PRINT C;". ";A
70 NEXT C
80 STOP
```

While this is no longer randomness, it does prevent the same number from immediately repeating. Lines 40 and 50 now act to inhibit the RND function by not allowing the same number to repeat. If A equals B, then the program will go back to line 30 to get another number. It will keep doing so until A does not equal B. When this happens, A will pass through and B will change to equal the new value of A.

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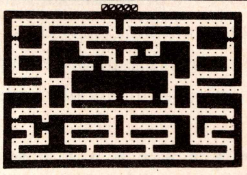

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The Game

Now all that remained was to adapt the game I had been developing with this method. "Space Crisis" in Listing 3 is the result. It uses the RND function in both the free and inhibited modes.

The plot "Space Crisis" revolves around a spaceship that is returning from a mission to a distant galaxy. The game starts with the spaceship in hyper-warp. ALEC, the on-board command computer, announces that the ship will leave hyper-warp and return to normal space. When the ship emerges into normal space (indicated by a star field appearing on the ship's viewscreen), ALEC begins a routine announcement which includes the fact that he is taking back control of the ship. At this point, the crew begins to suspect that there is something wrong with ALEC. Their suspicions are confirmed as ALEC shows definite signs of trouble when his report breaks up.

ALEC then begins a pseudo-conversation with one of his former programmers, Professor Cypher, which resolves itself into a deadly game of questions and answers on the Solar System as the ship hurtles toward certain destruction on Moonbase 2. The crew must rely on their own memories to answer ALEC's questions because the ship's library is locked up in ALEC's memory banks and is no longer available to them.

When the ship enters normal space, it is traveling at a speed of 18000 mph. A safe speed for approach to docking at Moonbase 2 is 1000 mph, at which time the docking computer takes over from ALEC and docks the ship. Each time the crew answers a question correctly, ALEC reduces the ship's speed by 1000 mph. A wrong answer does not reduce the speed. Each time a question is asked, the calculated speed is reduced by 500 mph. (The calculated speed is the speed required for a safe docking at Moonbase 2.)

If the calculated speed goes below 1000 mph before the actual speed reaches 1000 mph, the ship will crash. If the actual speed reaches 1000 mph before the calculated speed, the docking computer will take over from ALEC, and the ship can land safely. Only the crew's knowledge of the Solar System can save them.

The game begins when RUN is ENTERed. After a few seconds, a simulated viewscreen and control panel will appear. The viewscreen is blank since the ship is in hyper-warp. ALEC's announcement that the ship is leaving hyper-warp appears on the viewscreen. The entire screen will go blank for about 27 seconds (a long time for computer work, I'll agree). At the end of this period, a star field will appear on the ship's viewscreen, indicating that the ship is now in normal space. A few seconds later, ALEC begins his routine announcement, and his malfunction appears. This is followed by his conversation with Professor Cypher, which is then followed by ALEC laying down the rules for the game.

A prompt "L" should appear in the lower left-hand corner of the TV screen. This indicates that it is time for the player to enter the game.

The game is played by the player reading the question appearing on the viewscreen, and then ENTERing the name of a planet. (Misspelling the name of the planet is counted as a wrong answer.) When the ENTER key is pressed, the screen will display the player's answer and the correct answer. At the same time, the computer will adjust the actual speed and the calculated speed to show the correct values.

Win or lose, there will be an "end of game" message. After the message, the player will be asked if he would like to play again. If the answer is "Y", the game will start with the questions; most of the graphics and all of the instructions are bypassed. If the answer is "N", the program goes to 1999 which is the end.

The Star Field

I have used a random generator to generate the star field that appears on the ship's viewscreen. The process could be

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Listing 3. Space Crisis.

```
 10 REM "SPACE CRISIS"
 12 REM BY:   RONALD W. DUGUID
              4352 GROW RD. NW
              STANTON, MI 48888
 13 REM       OCTOBER 30, 1982
 15 REM ZX81      8K ROM/16K RAM
 18 LET P=0
 20 LET A=0
 22 LET G=0
 24 LET H=0
 26 LET J=0
 28 LET K=0
 32 LET M=0
 34 LET N=0
 38 LET Q=0
 40 LET SA=18000
 42 LET SC=18000
 44 LET QR=0
165 CLS
170 FAST
175 FOR A=1 TO 60
180 PLOT A,41
185 NEXT A
190 FOR A=1 TO 60
195 PLOT A,10
200 NEXT A
205 FOR A=1 TO 60
210 PLOT A,4
215 NEXT A
220 FOR A=1 TO 60
225 PLOT A,0
230 NEXT A
235 FOR A=1 TO 4
240 PLOT 1,A
245 NEXT A
250 FOR A=1 TO 4
255 PLOT 22,A
260 NEXT A
265 FOR A=1 TO 4
270 PLOT 44,A
275 NEXT A
280 FOR A=1 TO 4
285 PLOT 60,A
290 NEXT A
295 FOR A=1 TO 31
300 PLOT 1,10+A
305 NEXT A
310 FOR A=1 TO 31
315 PLOT 60,10+A
320 NEXT A
322 PRINT AT 18,1;"SPEED(ACT)";
TAB 12;"SPEED(CAL)";TAB 23;"CONT
ROL"
 323 IF P=1 THEN GOTO 990
 324 PRINT AT 20,1;"HYPER-WARP";
TAB 12;"HYPER-WARP";TAB 23;"ALEC
"
 325 PAUSE 750
 330 SLOW
 333 PRINT AT 3,2;"ALEC HERE-PRE
PARE TO LEAVE"
 334 PRINT AT 4,2;"HYPER-WARP. N
ORMAL SPACE"
 335 PRINT AT 5,2;"IN 27 SECONDS
"
 337 PAUSE 350
 338 FAST
 339 LET H=1
 340 FOR G=1 TO 29
 342 LET J=INT (RND*10)+1
 344 IF J=1 THEN GOTO 350
 346 IF J>=2 THEN GOTO 355
 350 PRINT AT H,G;"■"
 352 GOTO 360
 355 PRINT AT H,G;"■"
 360 IF G<=28 THEN GOTO 390
 370 LET H=H+1
 375 IF H>=17 THEN GOTO 392
 380 GOTO 340
 390 NEXT G
 396 LET C$="BRIDGE"
 398 PRINT AT 20,1;SA;TAB 6;"/MP
H ";TAB 12;SC;TAB 17;"/MPH ";TAB
 23;C$
 400 PAUSE 500
 405 SLOW
 410 PRINT AT 2,2;"ALEC HERE-WE
HAVE EMERGED"
 420 PRINT AT 3,2;"FROM HYPER-WA
RP AND ARE"
 430 PRINT AT 4,2;"NOW MOVING AT
 A SUB-LIGHT"
 440 PRINT AT 5,2;"SPEED OF 1800
0/MPH. WE ARE"
 450 PRINT AT 6,2;"APPROACHING O
UR SOLAR"
 460 PRINT AT 7,2;"SYSTEM. I WIL
L TAKE"
 470 PRINT AT 8,2;"CONTROL OF TH
E SHIP FOR"
 480 PRINT AT 9,2;"DECELERATION
TO DOCKING"
 490 PRINT AT 10,2;"APPROACH FOR
 MOON BASE 2."
 495 PRINT AT 20,23;"ALEC  "
 500 PRINT AT 11,2;"I WILL DE-CO
NTROL AT 1000"
 510 PRINT AT 12,2;"MPH TO LET T
HE DOCKING"
 520 PRINT AT 13,2;"COMPUTER TAK
E CONTROL OF"
 530 PRINT AT 14,2;"THE SHIP. OU
R ETA IS--AWK?"
 540 PRINT AT 15,2;"**MARY HAD A
??1+1=2//BLEEP??"
 550 PAUSE 1500
 553 LET H=2
 555 GOSUB 2000
 640 PRINT AT 2,2;"PROFESSOR CYP
HER HERE-ALEC,"
 650 PRINT AT 3,2;"YOU HAVE NOT
BEEN STUDYING"
 660 PRINT AT 4,2;"YOUR INFORMAT
ION TAPES."
 670 PRINT AT 5,2;"YOU HAVE WRON
G ANSWERS ON"
 680 PRINT AT 6,2;"ALL THE QUEST
IONS ABOUT"
 690 PRINT AT 7,2;"OUR SOLAR SYS
TEM. YOU WILL"
 700 PRINT AT 8,2;"HAVE TO DO TH
EM OVER."
 710 PRINT AT 10,2;"CAN THE CREW
 HELP ME?"
 720 PRINT AT 12,2;"OF COURSE, T
HEY CAN. AND,IF"
 730 PRINT AT 13,2;"THE ANSWERS
ARE CORRECT, YOU"
 740 PRINT AT 14,2;"CAN CONTROL
THE SHIP."
 750 PAUSE 1000
 760 GOSUB 2000
 770 PRINT AT 2,2;"YES, PROFESSO
R, AND FOR A"
 780 PRINT AT 3,2;"CORRECT ANSWE
R, I WILL"
 790 PRINT AT 4,2;"DECELERATE TH
E SPEED BY"
 800 PRINT AT 5,2;"1000 MPH. THE
Y MUST REDUCE"
 810 PRINT AT 6,2;"THE SHIP SPEE
D TO 1000 MPH"
 820 PRINT AT 7,2;"BEFORE THE CA
LCULATED SPEED"
 830 PRINT AT 8,2;"REACHES 1000
MPH, OR THEY"
 840 PRINT AT 9,2;"WILL CRASH ON
 MOONBASE 2."
 850 PRINT AT 11,2;"QUESTIONS AR
E ANSWERED BY"
 860 PRINT AT 12,2;"ENTERING A P
LANET NAME."
 870 PRINT AT 14,2;"ARE YOU READ
Y, CREW? Y OR N"
 880 INPUT B$
 890 IF B$="Y" THEN GOTO 990
 900 IF B$="N" THEN GOTO 940
 920 IF B$<>"N" THEN GOSUB 3000
 930 GOTO 870
 940 GOSUB 2500
 950 GOTO 3500
 990 PRINT AT 20,23;"      "
 992 PRINT AT 20,1;SA;TAB 6;"/MP
H ";TAB 12;SC;TAB 17;"/MPH ";TAB
 23;"ALEC"
1000 GOSUB 2000
1003 PRINT AT 2,1;"NAME THE PLAN
ET THAT:"
1010 LET QR=INT (RND*27)+1
1015 IF QR=K THEN GOTO 1010
1020 LET K=QR
1025 IF QR<=3 THEN LET Q$="MERCU
RY"
1030 IF QR>3 AND QR<=6 THEN LET
Q$="VENUS"
1035 IF QR>6 AND QR<=9 THEN LET
Q$="EARTH"
1040 IF QR>9 AND QR<=12 THEN LET
 Q$="MARS"
1045 IF QR>12 AND QR<=15 THEN LE
T Q$="JUPITER"
1050 IF QR>15 AND QR<=18 THEN LE
T Q$="SATURN"
```


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```
1055 IF QR>18 AND QR<=21 THEN LE
T Q$="URANUS"
1060 IF QR>21 AND QR<=24 THEN LE
T Q$="NEPTUNE"
1065 IF QR>24 AND QR<=27 THEN LE
T Q$="PLUTO"
1070 LET Q=1200+(QR*4)
1075 GOTO Q
1200 REM SOLAR QUESTIONS
1204 PRINT AT 3,2;"IS FIRST IN L
INE FROM THE"
1205 PRINT AT 4,2;"SUN."
1207 GOTO 1350
1208 PRINT AT 3,2;"REVOLVES AROU
ND THE SUN ONCE"
1209 PRINT AT 4,2;"EVERY 88 DAYS
."
1211 GOTO 1350
1212 PRINT AT 3,2;"HAS A SURFACE
 TEMPERATURE OF"
1213 PRINT AT 4,2;"430 DEG. C ON
 THE DAY SIDE,"
1214 PRINT AT 5,2;"-170 C ON THE
 NIGHT SIDE."
1215 GOTO 1350
1216 PRINT AT 3,2;"IS 2ND IN LIN
E FROM THE SUN."
1219 GOTO 1350
1220 PRINT AT 3,2;"IS COVERED WI
TH THICK CLOUDS"
1221 PRINT AT 4,2;"OF SULFURIC A
CID."
1223 GOTO 1350
1224 PRINT AT 3,2;"REVOLVES AROU
ND THE SUN ONCE"
1225 PRINT AT 4,2;"EVERY 225 DAY
S."
1227 GOTO 1350
1228 PRINT AT 3,2;"IS 3RD IN LIN
E FROM THE SUN."
1231 GOTO 1350
1232 PRINT AT 3,2;"IS THE ONLY P
LANET KNOWN TO"
1233 PRINT AT 4,2;"SUPPORT LIFE.
"
1235 GOTO 1350
1236 PRINT AT 3,2;"IS 149,600,00
0 KM FROM THE"
1237 PRINT AT 4,2;"SUN. (APPROX.
 93 MILLION"
1238 PRINT AT 5,2;"MILES.)"
1239 GOTO 1350
1240 PRINT AT 3,2;"IS 4TH IN LIN
E FROM THE SUN."
1243 GOTO 1350
1244 PRINT AT 3,2;"IS KNOWN AS-T
HE RED PLANET."
1247 GOTO 1350
1248 PRINT AT 3,2;"HAS A VARIABL
E SURFACE"
1249 PRINT AT 4,2;"TEMPERATURE A
VERAGING MINUS"
1250 PRINT AT 5,2;"50 DEG C."
1251 GOTO 1350
1252 PRINT AT 3,2;"IS 5TH IN LIN
E FROM THE SUN."
1255 GOTO 1350
1256 PRINT AT 3,2;"REVOLVES AROU
ND THE SUN ONCE"
1257 PRINT AT 4,2;"EVERY 11.86 Y
EARS."
1259 GOTO 1350
1260 PRINT AT 3,2;"HAS A MAJOR M
OON NAMED-"
1261 PRINT AT 4,2;"EUROPA."
1263 GOTO 1350
1264 PRINT AT 3,2;"IS 6TH IN LIN
E FROM THE SUN."
1267 GOTO 1350
1268 PRINT AT 3,2;"IS THE 2ND LA
RGEST PLANET IN"
1269 PRINT AT 4,2;"OUR SOLAR SYS
TEM."
1271 GOTO 1350
1272 PRINT AT 3,2;"HAS SEVEN RIN
GS."
1275 GOTO 1350
1276 PRINT AT 3,2;"IS 7TH IN LIN
E FROM THE SUN."
1279 GOTO 1350
1280 PRINT AT 3,2;"HAS NINE RING
S."
1283 GOTO 1350
1284 PRINT AT 3,2;"HAS A TEMPERA
TURE OF -215"
1285 PRINT AT 4,2;"DEG. C AT THE
 CLOUD TOPS."
1287 GOTO 1350
1288 PRINT AT 3,2;"IS 8TH IN LIN
E FROM THE SUN."
1291 GOTO 1350
1292 PRINT AT 3,2;"HAS A MOON NA
MED-TRITON."
1295 GOTO 1350
1296 PRINT AT 3,2;"REVOLVES AROU
ND THE SUN ONCE"
1297 PRINT AT 4,2;"EVERY 165 YEA
RS."
1299 GOTO 1350
1300 PRINT AT 3,2;"IS 9TH IN LIN
E FROM THE SUN."
1303 GOTO 1350
1304 PRINT AT 3,2;"IS THE SMALLE
ST PLANET IN"
1305 PRINT AT 4,2;"OUR SOLAR SYS
TEM."
1307 GOTO 1350
1308 PRINT AT 3,2;"HAS A MOON NA
MED-CHARON."
1350 INPUT A$
1353 PRINT AT 8,2;"   YOUR ANSWE
R-";A$
1354 PRINT AT 10,2;"CORRECT ANSW
ER-";Q$
1355 IF A$=Q$ THEN GOTO 1365
1360 IF A$<>Q$ THEN GOTO 1390
1365 LET SA=SA+1000
1375 PRINT AT 20,1;"      "
1385 PRINT AT 20,1;SA
1390 IF SA<=1000 AND SC>=1000 TH
EN GOTO 1500
1400 LET SC=SC-500
1420 PRINT AT 20,12;"      "
1430 PRINT AT 20,12;SC
1433 PAUSE 500
1435 IF SC>=1000 THEN GOTO 1450
1440 IF SC<1000 THEN GOSUB 2500
1445 GOSUB 3500
1460 GOSUB 2000
1465 GOTO 1003
1500 REM SAFE LANDING
1510 PRINT AT 20,23;"DOCKING"
1520 PAUSE 250
1535 GOSUB 2000
1540 PRINT AT 2,2;"******CONGRAT
ULATIONS******"
1550 PRINT AT 4,2;"YOU HAVE SURV
IVED THE"
1560 PRINT AT 5,2;"CRISIS. PREPA
RE, NOW, FOR A"
1570 PRINT AT 6,2;"SAFE LANDING
ON MOONBASE 2."
1580 PAUSE 1000
1590 GOSUB 3500
1998 REM NEXT LINE ENDS PROGRAM
1999 STOP
2000 REM CLEAR SHIP'S SCREEN
2010 FAST
2020 LET H=2
2030 PRINT AT H,1;"
                "
2040 LET H=H+1
2050 IF H>=16 THEN GOTO 2085
2060 GOTO 2030
2085 SLOW
2090 RETURN
2500 REM CRASH MESSAGE
2505 GOSUB 2000
2510 PRINT AT 2,2;"ALL HOPE IS G
ONE."
2512 PRINT AT 3,2;"PREPARE FOR D
ISASTER."
2515 PAUSE 100
2520 PRINT AT 6,2;"GOODBY   GOOD
BY   GOODBY"
2530 PAUSE 500
2540 PRINT AT 14,11;"**CRASH**"
2545 PAUSE 250
2550 RETURN
3000 REM IMPROPER INPUT ROUTINE
3001 GOSUB 2000
3010 PRINT AT 2,2;"*IMPROPER INP
UT-PLEASE WAIT*"
3020 PAUSE 500
3030 GOSUB 2000
3040 RETURN
3500 CLS
3510 PRINT "DO YOU WISH TO PLAY
AGAIN?"
3515 PRINT "Y OR N"
3520 INPUT B$
3530 IF B$="Y" THEN GOTO 3570
3540 IF B$="N" THEN GOTO 1999
3550 IF B$<>"N" THEN GOSUB 3000
3560 GOTO 3500
3570 LET P=1
3580 GOTO 20
```


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speeded up by using a fixed star field, but I decided to keep the random generator because it is such a good visual representation of the RND function. I did not use the inhibit instructions with this particular RND statement, so it will run freely, generating what it will.

Some of you may wish to view the generation of the star field in the SLOW mode. To do this, change line 338 FAST to 338 SLOW, and add 392 STOP. The program will progress through the star field in SLOW mode, and then STOP. To see it again, just press RUN and ENTER and a new star field will be generated.

The star field random generator is in

342 LET J=INT(RND*10)+1

You might want to vary the density of the star field by changing the value of the multiplier. I used a multiplier of 10 because it produced a star field that was pleasing to me. If you decrease the multiplier, the density will increase. If you increase the multiplier, the density will decrease. In any event, I think you will find it as fascinating as I did.

I mentioned before that this RND function was not inhibited. While using a multiplier of 5, the random generator produced 5 stars in a row on one star field. This indicated that the number 1 had repeated immediately five times. This is the highest number I saw. Perhaps you will see more.

The random generator used for the selection of questions is inhibited. This generator is in

1010 LET QR=INT(RND*27)+1

The inhibit statements are:

1015 IF QR=K THEN GOTO 1010

1020 LET K=QR

Inhibiting the star field generator would have reduced the realistic look for the star field, but not inhibiting the question generator would have allowed the same question to repeat one or more times with the result that the whole program would have looked silly.

In Closing

I would like to wax philosophical on the subject of "randomness" for a moment, and ask the question: Is it possible to find true randomness in this three-dimensional, two-state universe? It would seem that a tree being struck by lightning would be a truly random event. But, on reflection, a tree standing in the middle of a thunderstorm would have a good chance of being struck, while a tree standing under a sun-bright, cloudless sky would not have any chance at all. So, here too, is a condition—the tree must be standing in a thunderstorm in order to have a chance of being struck by lightning. True randomness may exist, but I believe, now, that it will not be immediately obvious.

Notes:

1) The graphics characters and other elements used in "Space Crisis" are:

350: Inverse asterisk.

355: Inverse space.

1353: Three spaces before "### YOUR...

2030: 29 normal spaces between quotation marks.

2) An underlined word in a program indicates that it is a single-stroke keyword or function.

3) I would recommend that you write the program and, after de-bugging, SAVE it before you do any of the modifications that I suggest in the article.

Ed.—For the convenience of our readers the author will supply Listings 1 and 3 on cassette for $3 including postage. Readers outside the U.S. should include in the payment enough to cover the additional cost of postage for about 2 ounces. ■

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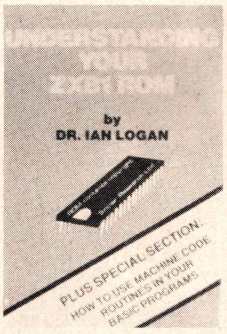

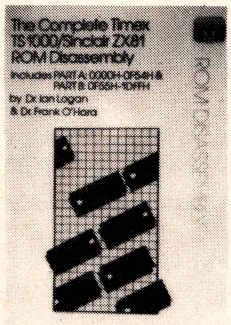

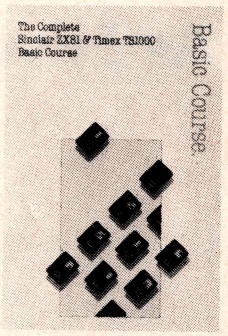

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Harry Doakes

Ever thought about learning to program in machine code?

Maybe you have. Maybe you even got far enough to open one of those thick books full of jargon and technical details. Maybe you got far enough into it to be scared away.

But chances are, you just could not make any sense of it. All the talk about hexadecimal and bus structures and pseudo-ops and gobbledygook ....

Let us try a different approach. Machine code programming is, first of all, programming. You already know how to program in Basic; that means you are already on the way to programming in machine language.

What Is in a Name?

Every language has a name. Some languages have more names than they really need, and that is the case with machine code programming.

You may hear people talk about mnemonics, or source code, or assembler code, or assembly language. They will also refer to object code, or numerical code, or hex code.

Do not panic—it is all the same thing.

Take a look at Figure 1. On the left is a string of numbers, while on the right we see something that looks like a regular sort of programming language. They both represent the same program. The numerical version is for the Z80 microprocessor, the "brain" of your computer—it only understands numbers. Since it is a little tough for human beings to remember what all those numbers mean, the version on the right translates the program into words. But—line for line—both versions mean exactly the same thing.

It is easier for us to use a word like "ADD" than to remember what function 198 does, so we write machine code programs in this more human kind of language. Then it is a simple matter to convert each line into the numbers the computer understands. This way, no one has to remember the numbers; for machine code programming, you only need to learn a new programming language that uses words you can recognize.

Harry Doakes, PO Box 10860, Chicago, IL 60610.

Figure 1. Machine Code Program.

```
42, 12, 64          LD HL, (16396)
22, 22              LD D, 22
1, 254, 0           LD BC, 254
35          LOOP:   INC HL
126                 LD A, (HL)
254, 118            CP 118
40, 10              JR Z, NEXT
198, 128            ADD A, 128
119                 LD (HL), a
237, 120            IN A, (C)
254, 63             CP 63
192                 RET NZ
24, -16             JR LOOP
21          NEXT:   DEC D
32, -19             JR NZ, LOOP
201                 RET
```

Why Me?

Maybe you are thinking one taste of this is enough. Why should anybody have to go through all the trouble of figuring out this arcane language; except for a few things—such as "loop" and "next"—this is not even English. Maybe it is a better idea to stick to Basic.

Well ... remember the first time you saw a computer program? Even if it was in Basic, you probably could not figure out what it meant. That is because Basic is another language; though it is similar to English, and uses English words, you had to learn a whole new set of rules for using the words.

Although it may not look much like it, that "human" version in Figure 1 is full of English words, too. You probably do not recognize them because they are all abbreviations. Some are for familiar words that mean just what they sound like: "RET" means "return," which is the same as in Basic—it is for returning from a subroutine. "CP" is "compare," for comparing one number to another.

Why should you learn a whole new language when you already know Basic? The answer is simple. Machine code is compact. Machine code is powerful. Most of all, machine code is *fast*.

How fast? Well, let's try this program and see.

A Day at the Races

If your Sinclair computer cannot operate in SLOW mode, this demonstration might not be very impressive. But follow along anyway; it works with either the 4K or 8K ROM.

First, we cannot enter machine code directly into the computer. It will accept commands only in Basic. So we must make some space for the routine. With the 4K ROM you can do that by typing

```
PRINT USR (620)
```

That will reserve 12 bytes of memory at the top of RAM. This program is longer than that, so you will need to do it twice more. Be sure you type it in each time. You cannot just make a program out of it, because it works like a NEW command—it wipes out the whole program each time it runs.

With the 8K ROM, run this short program:

```
10 POKE 16388,-30
20 POKE 16389, PEEK 16389-1
30 NEW
```

That will give you 30 bytes of space at the top. You can change the amount of space you have by changing the POKE in line 10.

We will use the Basic program in Listing 1 to get our machine code routine working. Type it in—*but do not run it yet!* (If you have the 4K ROM, remember to use parentheses with all the functions.)

Listing 1. Loader Program for Machine Code Program.

```
10 LET Q=17380
20 FOR A=O TO 27
30 PRINT A; "########";
40 INPUT B
50 POKE A+Q,B
60 PRINT PEEK (A+Q),
70 NEXT A
80 FOR A=1 TO 100
90 NEXT A
100 LET B=USR Q
110 STOP
```

The program in Listing 1 is designed for 1K RAM. That is what comes on a ZX80 or ZX81. If you have a Timex/Sinclair 1000, you

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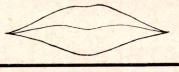

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have 2K RAM, and you should change line 10 to read

10 LET Q=18404

If you are using a 16K RAM module, change it to

10 LET Q=32740

Now run the program, and enter the numbers in the left column of Figure 1. When you get to the last number, the screen should look like this:

0	42	1	12
2	64	3	22
4	22	5	1
6	254	7	0
8	35	9	126
10	254	11	118
12	40	13	10
14	198	15	128
16	119	17	237
18	120	19	254
20	63	21	192
22	24	23	240
24	21	25	32
26	237	27	201

If you have typed a wrong number, hit BREAK and start again.

Now hit ENTER (or NEW LINE) again, and watch what happens.

What *did* happen? Suddenly—*very* suddenly—the whole screen was reversed.

That is the speed of machine code. It is the fastest that the computer can work.

There is even a way to test how fast it really is. You can stop a program in Basic by hitting the BREAK key. This machine code routine can be stopped by hitting *any* key while it is running.

So run the program again—and this time, as soon as you see it starting to reverse the screen, hit a key to stop it. Good luck trying to catch it, though—it runs very, *very* fast.

Riding the Fast Track

What exactly is going on here? One way to get an idea is to look at a Basic version of the machine code routine. It is in Listing 2.

Listing 2. Basic Version of Figure 1.

```
200 LET D=22
210 LET H=PEEK 1696+256*PEEK
16397
220 LET H=H+1
230 LET A=PEEK H
240 IF A=118 THEN GOTO 280
250 LET A=A+128
260 POKE H, A
270 GOTO 220
280 LET D=D-1
290 IF D>O THEN GOTO 220
300 RETURN
```

The subroutine works by using one of the Basic system variables, a number called D-FILE. This tells the computer where, in memory, what is on the TV screen is kept. Then the program runs through all 22 lines of the display (that is why D equals 22 to begin with). It adds 128 to the value of each character (that is, reverses it) except for the special, invisible NEWLINE character at the end of each line (that is the IF in line 240).

Even if you do not quite follow exactly how it works, you can type it in along with the program you already have. Replace lines 40 and 100 with

40 GOTO 60

100 GOSUB 200

You will see the difference. In Basic, it is *slow.* In machine code, it is *fast.*

You know what that means. The trouble with most programs is they are not fast enough. That is especially true with games; it seems to take forever for things to move around on the screen in Basic.

You have already seen how fast they can move in machine code.

Ready to ride the fast track? I will try to keep the gobbledygook to a minimum, and explain things as we go along. With some practice, you will not only be able to run machine code programs, but you will also understand what is going on—and even start writing machine code routines yourself.

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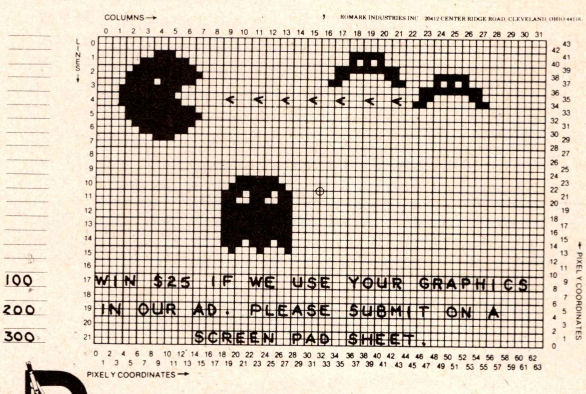

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As Easy As 2 + 2

Let's start out with something a little simpler than that fancy screen-blitzing program: adding 2 and 2. In Basic, it is pretty simple:

```
LET A=2+2
```

will do the trick. With machine code, it is only a little more complicated:

```
LD A,2
ADD A,2
```

Yes, ADD means just what you think it does—but first things first.

LD is short for "load." In Basic you LOAD a program (from your cassette recorder). In machine code, you "load" a number. As you might suspect, "load" is almost exactly like LET in Basic. So

```
LD A,2
```

means the same thing as

```
LET A=2
```

—both lines put the number 2 into the variable A.

... Except that it is not *exactly* a variable in the machine code version. The A is a *register*—a special memory location that is located right inside the Z80 microprocessor that runs your computer. Unlike a Basic variable, a register can only hold a number from 0 to 255. However, being inside the brain of the computer, a register can move numbers around much faster than a Basic variable can.

The Z80 has more than 20 registers. Some of them we cannot use without crashing the system of the Sinclair computer, because they are used almost constantly in the SLOW mode. Let's start out by looking at another half dozen registers that we can use.

Their names are registers B, C, D, E, H, and L. (These one-letter names are really just for the benefit of programmers. To the computer, they are all just numbers.)

The registers work like Basic variables. Just as you can

```
LET B=C
```

in Basic, you can

```
LD B,C
```

in machine code. You can load any of these registers into any other register. You can also load any number from 0 to 255 into any of the 7 registers—for example,

```
LD E,67
LD H,212
```

Bigger and Better

Better still, you can load in even bigger numbers—up to 65535—by using two registers at once. For example,

```
LD BC, 32000
```

or

```
LD HL,999
```

Maybe you are wondering how this works. After all, you are not just adding these two registers together. 65535 is hundreds of times higher than 255.

It works something like regular decimal numbers. Suppose you write a number with just one digit. The largest number you can write is 9.

Now write a number with two digits. Suddenly the highest number you can reach is 99. The new digit—the one on the left—is worth 10 times as much as the one on the right. That is why the biggest number you can get with two digits is more than 10 times what you can reach with one digit.

When you use two registers, the second register is worth *256 times* what it usually is.

But you cannot use just any two registers together this way. They work together in pairs; the pairs are always B and C, D and E, or H and L. They are sometimes called the BC register pair, the DE register pair, and the HL register pair, and it is always the *first* register—B, D, or H—that is worth 256 times its usual value.

So, for example, if you

```
LD BC,32000
```

the computer puts 32000/256 (that is 125) into register B, and the remainder (in this case, 0) into register C. It has the same effect as

```
LD B,125
LD C,0
```

except it is only one instruction instead of two. Similarly,

```
LD HL,999
```

has the same effect as

```
LD H,3
LD L,231
```


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Maybe you have noticed that register A is not part of a register pair. It has not really been left out: register A is special. It can do lots of things that the other registers cannot.

Like adding, for instance.

Add Another Instruction

In Basic you can add to any variable. In machine code, though, you can only add to one of the registers, register A. You can also add to just one of the register pairs—the HL register pair.

In other words, you can say

```
ADD A,B
```

which works like

```
LET A=A+B
```

in Basic. Likewise, you can say

```
ADD HL,BC
```

which in Basic might be

```
LET HL=HL+BC
```

Do not get confused, though. You can only add a single register, or a number from 0 to 255, to register A, and you can only add a register pair. You cannot mix the two kinds—for example, you cannot add register pair A directly to register pair HL.

What if you *wanted* to add register A to register pair HL? You might do it like this:

```
LD B,0
LD C,A
ADD HL,BC
```

Once you have copied what is in register A into the BC register pair, you can add that to HL with no trouble.

What if you wanted to add register A to register pair HL? You might do it like this:

```
LD B,O
LD C,A
ADD HL,BC
```

Once you have copied what is in register A into the BC register pair, you can add that to HL with no trouble.

USR Friendly

Maybe you are feeling a little overloaded with machine code just now. Well, take a deep breath and relax for a moment, while we talk about something in Basic: the USR function.

USR is how we can run a machine code subroutine in the middle of a Basic program. When the computer hits a line like

```
PRINT USR 17380
```

it stops what it is doing and goes to work on the machine code routine beginning at memory location 17380.

It keeps working on it until it hits a RET instruction—the machine code "return." Then it returns to Basic, and picks up where it left off. This is a lot like GOSUB—only the subroutine is machine code, not Basic.

But wait—that line has a PRINT in it. What gets PRINTed on the display?

That depends. If you have the 8K ROM, the computer PRINTs the number that was in the BC register pair. If you are using the 4K ROM, it PRINTs the HL register pair.

You can use the USR function just like any other number. For example, you might say

```
LET A=USR 17380
```

or even

```
PRINT CHR$ (USR 17380)
```

This is very handy because it means that we can solve a problem in a machine code subroutine and then send the answer back to our main Basic program by loading the answer into HL or BC before we return to Basic.

It All Adds Up

Ready to add 2 and 2 now? Here is how we will do it—first, the addition:

```
LD A,2
ADD A,2
```

Then the result goes in register pair BC for the return to Basic:

```
LD B,O
LD C,A
```

For the benefit of 4K ROM users, we will put it in HL, too:

```
LD H,B
LD L,C
```

Finally, we return to Basic:

```
RET
```

Figure 2 shows this program, along with the numerical version the computer understands. (You can check the numbers in the appendix section of your ZX81 or T/S 1000 manual, under the heading "The Character Set.")

Figure 2. Machine Code Program for Adding 2 and 2.

62, 2	LD A,2
198, 2	ADD A,2
6,0	LD B,O
79	LD C,A
96	LD H,B
105	LD L,C
201	RET

Now you are ready to run it.

First, reserve space at the top of memory, as you did for the previous program. Then carefully type in the program in Listing 3. If you are using a system with more than 1K RAM, remember to change line 10 accordingly.

Listing 3. Loader Program for Figure 2.

```
10 LET Q=17380
20 FOR A=0 TO 9
30 PRINT A,
40 INPUT B
50 POKE A+Q,B
60 PRINT PEEK (A+Q)
70 NEXT A
```

Now run the program and type in the ten numbers in Figure 2. When you are finished, check carefully to make sure you have everything in the right order. It should look like this:

0	62
1	2
2	198
3	2
4	6
5	0
6	79
7	96
8	105
9	201

Now you are ready. Type

```
PRINT USR Q
```

and the answer on your screen should be—surprise!—4.

Care to experiment? You can add two different numbers together. Just change the 2's to other values. To add 7 and 3, for example, run the program in Listing 3 again. This time, the first four numbers you type should be

0	62
1	7
2	198
3	3

The rest of the numbers are as before. Type

```
PRINT USR Q
```

again to get the new result.

Try your own numbers. Remember, they should be between 0 and 255. If you use large numbers, notice what happens when the sum is larger than 255.

Coming Attractions

Adding 2 and 2 may not seem like a big deal—but it is just the beginning. Next time we will take a look at loops, and see how fast machine code can really run.

If you have comments or questions about machine code programming, or something is not quite clear, let me hear from you. Be sure to send along a stamped, self-addressed envelope if you need a reply. ■

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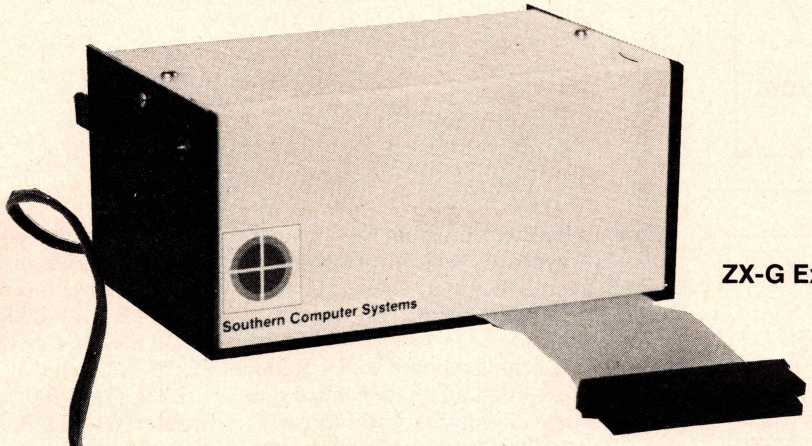

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8K Machine Code Keyboard Scanning

Sidney Belman

Bernard Puerzer's program for scanning the ZX80 keyboard ("Machine Code Keyboard Scanning Program,"*SYNC* 1:4) was written for the 4K ROM. His program served as the occasion to give the same ability to read the keyboard to 8K ROM users. This required adaptation since the programs are not automatically transferable. One of the problems was to get around the differences in the way that the index registers are used. This program avoids that problem. Further, it adds a WAIT loop which keeps the screen dark after ENTER is pressed and then prints the keyboard entry following ENTER. This loop is in addresses 20023 to 20026. It requires that ENTER be read first in addresses 20002 to 20016.

The port of entry from the keyboard is IN A,(FE) at address 20014. The keyboard enters as groups of 5 keys determined by which bit of A is off, i.e., equals zero. Thus, LD A,254 (before IN A,254) allows keys "Shift to V" to enter. Table 1 describes this situation. The key enters A with values as shown in the last column. Note that the values are from the periphery to the center. A binary representation of each number will show how the 0 bit shifts.

The group values are stored in address 25000, and the key values in address 25001. Addresses 20030-20064 calculate the address containing the codes for the keys which are stored in HL and the codes are transferred to address 25005 by addresses 20065 to 20068. Address 20069 is the RET. The codes are stored in addresses 20070 to 20109, in identical order as given by Puerzer. My address 20070 = his 17458, etc. I prefer to use 184 (inverse S) for Shift and 179 (inverse N) for ENTER.

Sidney Belman, 376 Edgewood Ave., Teaneck, NJ 07666.

To enter the code you can use the loader program in Listing 1. To run the program I use this routine:

```
200 LET K  USR 20000
210 PRINT CHR$ (PEEK 25005)
220 STOP
230 GOTO 200
```

I enter GOTO 200, press ENTER, and then press the desired key. CONT will repeat the program. ■

Table 1.

247	3	1 to 5	62, 61, 59, 55, 47
251	2	Q to T	same
253	1	A to G	same
254	0	Shift to V	same
239	4	0 to 6	same
223	5	P to Y	same
191	6	N/L to H	same
127	7	Space to B	same

Figure 1. Machine code Loading Program. (From Bernard Puerzer's article.)

```
 5 LET MARK=0
10 PRINT "ENTER STARTING
   ADDRESS"
20 INPUT A
30 PRINT A; " (1 sp.) "; PEEK (A)
40 INPUT B
60 IF B>255 THEN GO TO 130
70 POKE A,B
80 PRINT A; " (1 sp.) "; PEEK (A)
90 LET MARK=MARK +1
100 IF MARK < 10 THEN GO TO 110
105 CLS
107 LET MARK = 0
109 PRINT A; " (1 sp.) "; PEEK (A)
110 LET A = A+1
120 GO TO 30
130 STOP
```

Figure 3. Table from Puerzer's Article.

17458	1						
17459	63	17469	60	17478	28	17488	231
17460	61	17470	42	17479	37	17489	49
17461	40	17471	55	17480	36	17490	48
17462	59	17472	57	17481	35	17491	47
17463	38	17473	29	17482	34	17492	45
17464	56	17474	30	17483	53	17493	0
17465	41	17475	31	17484	52	17494	155
17466	43	17476	32	17485	46	17495	50
17467	44	17476	32	17486	58	17496	51
17468	54	17477	33	17487	62	17497	39

Figure 2. 8K Keyboard Scanning Program.

Address	Hex	Decimal	Comments
20000	0E	14	LD C, 1
20001	1	1	
20002	6	6	LD B,191 entry for N/L
20003	BF	191	
20004	18	24	JR 4
20005	4	4	
20006	CB	203	RLC B
20007	00	0	
20008	0E	14	LD C, 0
20009	0	0	
20010	78	120	LD A,B group entry code
20011	32	50	LD (25000), A
20012	A8	168	
20013	61	97	
20014	DB	219	IN A, (254) port for keyboard
20015	FE	254	
20016	FE	254	CP 63
20017	3F	63	
20018	28	40	JR Z -14 loop to 20006
20019	F2	242	
20020	81	129	ADD A,C
20021	FE	254	CP 63
20022	3F	63	
20023	28	40	JR Z-21 loop until next key
20024	EB	235	
20025	91	145	SUB C
20026	32	50	LD (25001),A store key value
20027	A9	169	
20028	61	97	
20029	00	0	NOP
20030	21	33	LD HL,20069 start calc. address
20031	65	101	
20032	4E	78	
20033	11	17	LD DE,5
20034	05	5	
20035	00	0	
20036	3A	58	LD A,(25000)
20037	A8	168	
20038	61	97	
20039	06	6	LD B,254
20040	FE	254	
20041	18	24	JR 3
20042	03	3	
20043	CB	203	RLC B
20044	00	0	
20045	19	25	ADD HL,DE
20046	B8	184	CP B
20047	20	32	JR NZ -6
20048	FA	250	
20049	11	17	LD DE,1
20050	01	1	
20051	00	0	
20052	3A	58	LD A, (25001)
20053	A9	169	
20054	61	97	

Address	Hex	Decimal	Comment
20055	C6	198	ADD A,192
20056	C0	192	
20057	06	6	LD B,127
20058	7F	127	
20059	CB	203	RLC B
20060	00	0	
20061	19	25	ADD HL, DE
20062	B8	184	CP B
20063	20	32	JR NZ -6
20064	FA	250	
20065	7E	126	LD A,(HL) code into A
20066	32	50	LD(25005),A
20067	AD	173	
20068	61	97	
20069	C9	201	RET
20070	Enter codes given by Puerzer starting with his address 17458. Keep the same sequence, but disregard the addresses given. See Figure 3.		
20109	Last entry		

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Installing a UHF Modulator

Randall Glidden

For those of you with a standard ZX81/Timex-Sinclair 1000, this article may not be of much interest since, without any peripheral devices, your computer will transmit a clear video display with most TVs. However, if you have added an external keyboard, a motherboard, or even just a 16K RAM pack you will probably have encountered those annoying little bands of interference that just will not go away, regardless of how much you reposition your computer or fiddle with the fine tuning. The problem arises from the square waves generated by all digital circuitry which are picked up very nicely at 63 MHz (you guessed it—channel 3). Shielding all components will do much to alleviate the situation, but the hard-core computer hack with motherboards, modems, and meters of wire-wrap may find it difficult or undesirable to put all that circuitry under aluminum. Also, shielding does not usually eliminate the problem entirely, as those with a ZX81 and 16K RAM alone will probably attest—the video quality is much better without the RAM pack plugged in.

A solution that is relatively inexpensive, easy to do, and (best of all) permanent, regardless of how much extra hardware you have, is to convert your ZX/TS to transmit over UHF channel 33 (146 MHz). At that frequency those nasty little digital spectral (Fourier) components go virtually undetected. It is interesting to note that European ZX81's *come* with a UHF-33 modulator instead of the VHF 2,3 found in the American model.

So if you are willing to invest about $15, a half hour of your time, and do not mind invading the inner sanctum of your computer (which will void the warranty of a factory assembled unit), then read on.

If you consult chapter 25 of *ZX81 Basic Programming*, you will find a nice photograph of the ZX81 hardware layout. (I assume there is a similar photo in the T/S 1000 programming book also.) The VHF video modulator is the small silver box in the upper left corner of the circuit board. (If you have a sharp eye, you will notice that the modulator in the photograph *is* a UHF modulator.) In this project all we need to do is replace this with a UHF channel 33 modulator. These are currently available from: Computer Continuum, 301 16th Ave., San Francisco, CA. 94118 (cost $15 ppd. with instructions, as of this writing). You may be able to find one for less at some discount electronics houses if you want to shop around a bit.

Once you get your channel 33 modulator get a 15-25 watt soldering iron, some rosin-core solder, a small Phillips-head screwdriver, and a pair of needle-nose pliers. Follow the steps below for interference free video!

1) Assemble all your materials in a clean, well-lit work area.

2) Remove the circuit board from your computer by removing the five Phillips-head screws from the back cover. Three of these screws are located under the little rubber pads at the corners. Note that the

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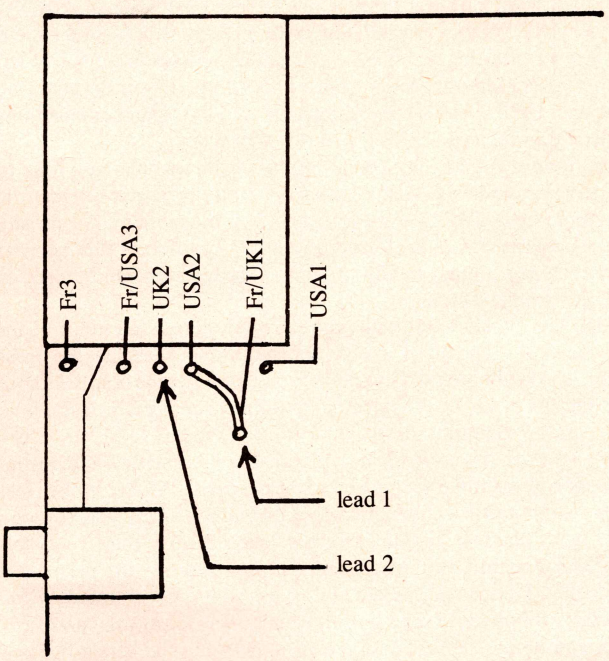
two screws at the front corners are shorter than the back three screws. Inside you will see two short screws holding the circuit board to the front cover. Remove these, carefully noting their exact location on the board (important when you reassemble). *Carefully* disconnect the keyboard leads by gently pulling them free. Be careful not to tear or kink these leads or you will have big problems later on.

3) Locate the modulator (see the photo in chapter 25) and disconnect the three leads from its lower end by heating the solder pads with your iron and pulling them free with the needle-nose pliers. Be careful not to pull too hard or you may damage the printed circuit traces on the board.

4) At this point the modulator is being held down by two solder lugs located on its underside at each end. Heat these from beneath the board and pull them free one end at a time. You may have to work it free a little bit at a time, heating one end then the other.

5) With the modulator removed you should be able to see printed markings on the circuit board, as noted in Figure 1 (e.g., Fr 3, UK 2, etc.). Note that there are only two leads on the UHF modulator, one protruding from a little insulator (Figure 2). Push the solder lugs of the UHF modulator into the holes one at a time while heating. You

Figure 1. Circuit Board Diagram.



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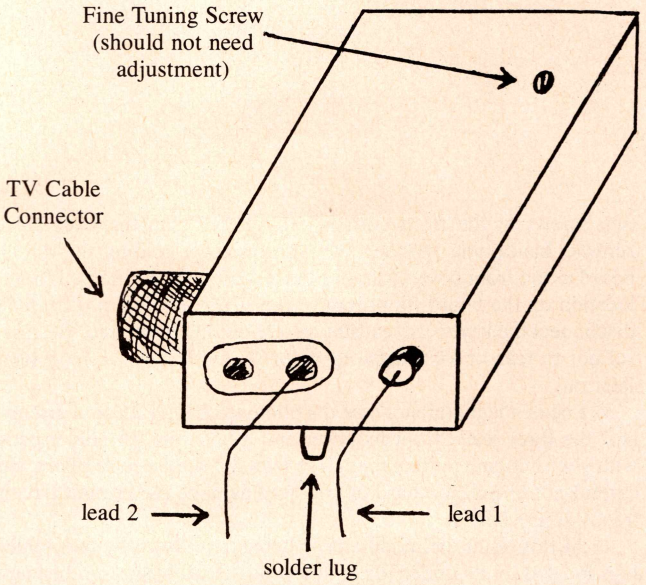
will notice that the jack for the TV cable is closer to the EAR jack than on the other modulator. Add extra solder to the lugs if needed, since these are the ground connections and should be secure.

6) Consulting the figures and the circuit board markings (which I hope you read before you soldered the modulator down over them), solder the lead from the insulator (lead 1) into the hole at the end of the line marked "Fr/UK 1". This is the 5V power source. Be sure to pull the lead through the board and trim any excess wire to prevent shorts.

Figure 2. UHF Video Modulator.



7) Solder lead 2 into the hole marked "UK 2" (Figure 1). This is the video signal from pin 16 of the Sinclair Computer Logic IC.

8) Make sure there are no shorts between the leads you have soldered and any of the printed circuit traces on the board (check both sides). Also be sure your solder joints are good at the leads and the solder lugs.

9) Now it is a good idea to see if the thing works before putting it back in its case. Plug the TV cable into the modulator, reposition the two leads from the antenna switch box to the UHF leads of your TV, turn to UHF channel 33, and plug in your power supply. You should see a nice, clear blank screen with the "K" cursor in the lower left corner, even without the keyboard hooked up. If you do not, fine tune your UHF tuner on the TV, recheck your modulator connections (is lead 2 in the right hole?), look for shorts, etc.

10) Before you can put your computer back together you have to cut a new hole in the side of the front cover to accommodate the different position of the TV cable jack. Use the mold marks already on the case (used with the European ZX's) as a guide. A piece of stiff wire wrapped around the tip of your soldering iron can be used to heat-cut a hole very easily.

11) Plug the keyboard tails into the sockets on the circuit board and carefully reposition it onto the mounting posts on the front cover. The keyboard tails should loop gently under the board without any creases or kinks. Replace the two *short* screws which hold the board to the mounting posts.

12) Replace the back cover, with the two short screws at the front corners and the three longer screws at the back. Put the rubber feet back, using a little rubber cement if they are not sticky any more.

Congratulations! You now have a video display that is crystal-clear and readable, even when loaded to the hilt with extra peripheral hardware. I hope this article will have also demonstrated to the Sinclair user the relative ease with which many hardware modifications can be performed, thus greatly enhancing the versatility and enjoyment of the ZX81 or T/S 1000. ■

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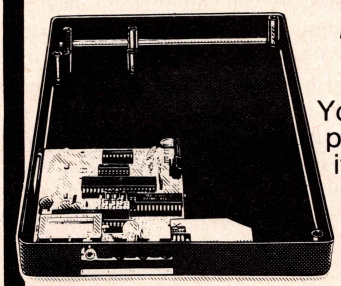

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A Cheap and Simple EPROM Programmer

Dan Schaaf

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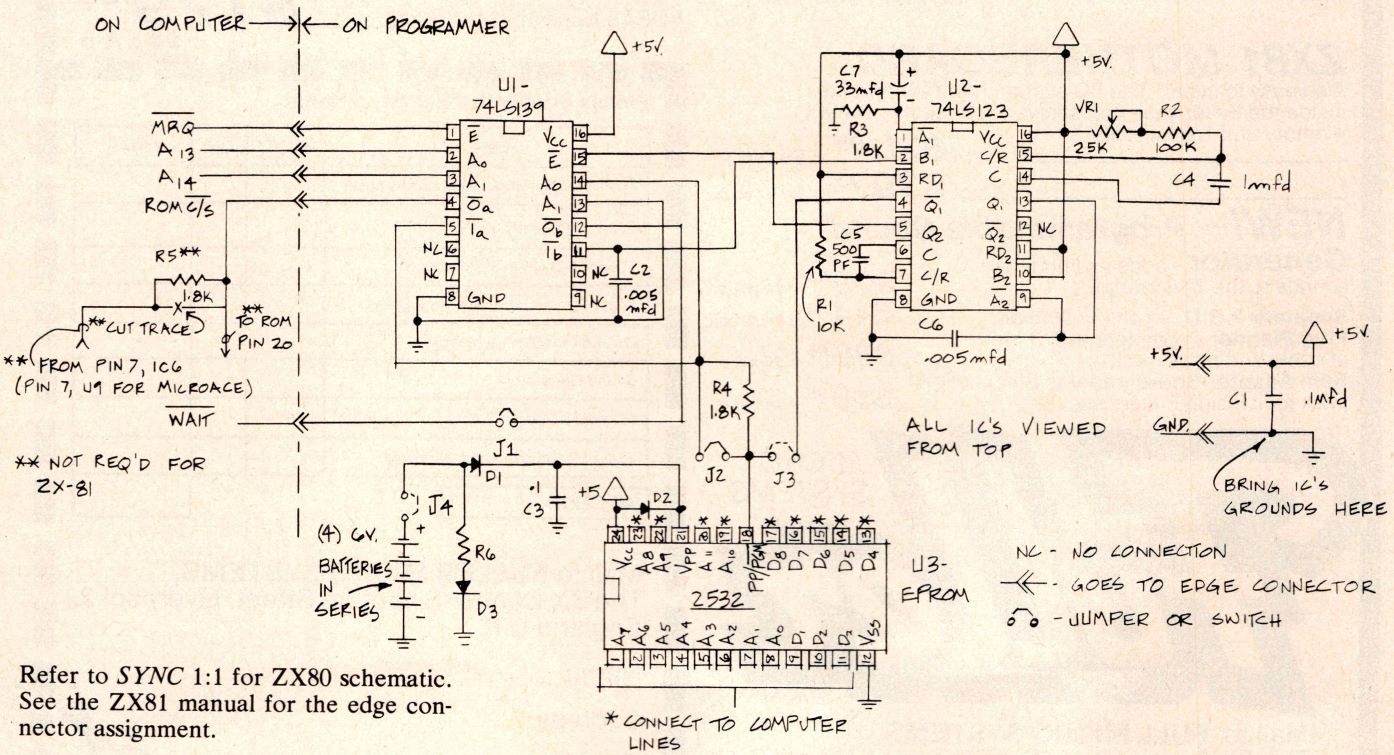
Figure 1. Schematic Diagram.



Refer to *SYNC* 1:1 for ZX80 schematic. See the ZX81 manual for the edge connector assignment.

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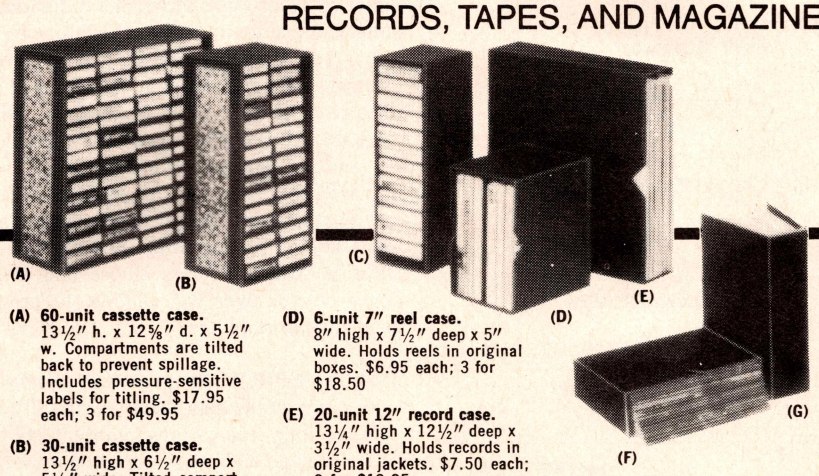

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2. Date of filing: October 1, 1982
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	Average No. Copies Each Issue During Preceding 12 Months	Actual No. Copies of Single Issue Published Nearest to Filing Date
A. Total no. copies printed *(net press run)*	13,166	19,798
B. Paid Circulation		
1. Sales through dealers and carriers, street vendors, and counter sales	676	795
2. Mail subscriptions	11,875	17,317
C. Total Paid Circulation *(sum of 10B1 and 10B2)*	12,551	18,112
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Figure 2. Timing Diagram.

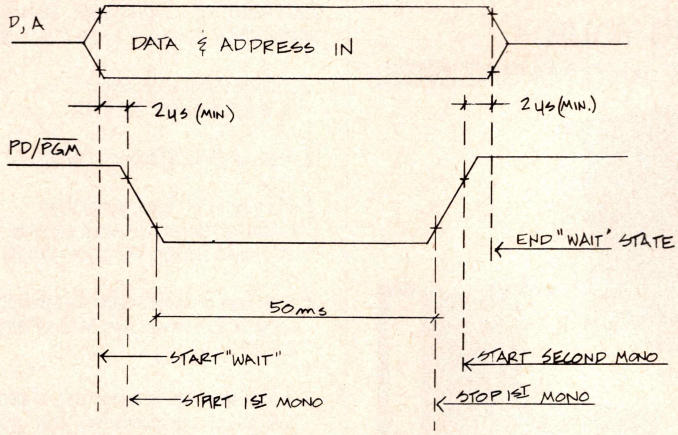
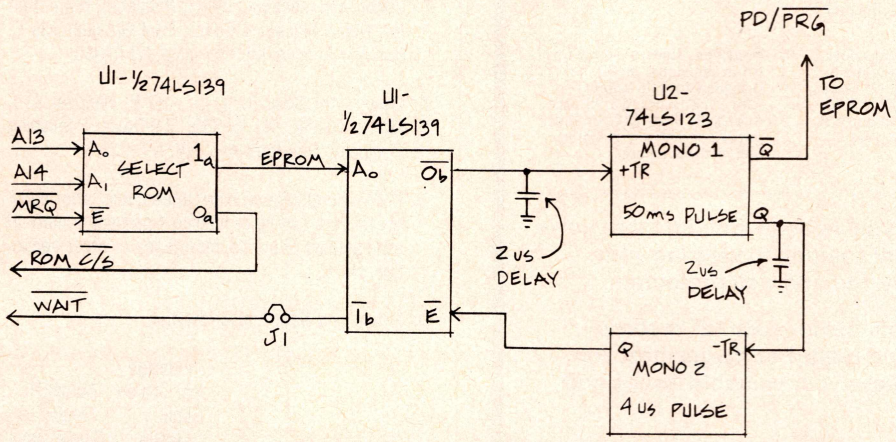


Figure 3. Block Diagram.



The Block Diagram shows how the basic EPROM timing needs are met by the circuit. As soon as a Memory Request is made into the EPROM, a Wait state is initiated. This holds data and addresses on the bus line until cleared by the timing loop. The beginning of the 50 ms pulse to the PD/PGM pin is delayed 2 μs (capacitor C2). 2 μs (capacitor C6) after the 50 ms pulse ends, a 4 μs pulse from the second mono clears the Wait state and allows the computer's bus lines to operate as normal.

Sinclair 4K Basic. Although not necessary since EPROMs come "erased" from the factory, it is useful to have or have access to an ultraviolet lamp for erasing the EPROM. They can be bought new for $70.00, but some can be found at flea markets and are sometimes known as rock hound lights used to fluoresce organic and other materials in rocks. At $70.00, it should be noted, however, seven fresh EPROMs could be bought.

Once built, programming proceeds by POKEing data into the proper addresses. USR is then used if the data was a machine language program, or PEEK if the data was a table, and also PEEK to check that programming worked properly.

What Is an EPROM?

EPROM stands for Erasable Programmable Read Only Memory. An EPROM has some of the same characteristics as the ROM in your machine that contains the Basic language:

1) Data may be read from the EPROM once an address has been presented to the address bus.

2) Data is retained when the power is turned off, almost forever.

There are differences: EPROMs need to be programmed a byte at a time; ROMs are made in large batches each with the same program on them. EPROMs can be erased (for reprogramming) by the use of ultraviolet radiation; ROMs can never be erased. In a sense, an EPROM is midway betway a ROM and a RAM. Typically an EPROM has the same gross dimensions as a ROM and the same pin-out as a ROM (since the computer uses both the same way) but in addition it has a little quartz window on top that allows the ultraviolet light into the EPROM for erasing. Erasing results in all data being lost at all addresses. There is no selective erasing.

How Does an EPROM Work?

The basic element of the EPROM is a capacitor which holds a charge. The estimated life time (time constant) of the charge is 7 to 10 years. Each bit is represented within the EPROM by one capacitor. A sensing amplifier converts this static charge to a TTL level voltage that appears on the data lines as either a "1" or "0". Ultraviolet radiation has sufficient energy to dislodge electrons on the capacitor surface, and as these photoelectrons are generated the capacitor will discharge and data will be erased. Most EPROMs read a discharged capacitor as a "1" and a charged capacitor as a "0"'. 25 volts are used to charge the 32,768 tiny capacitors on the chip. A typical ultraviolet lamp takes about half an hour to discharge the EPROM. Manufacturers advise that a tape cover be put over the window to prevent accidental erasure.

How the EPROM Programmer Works

Looking at the data sheets for the EPROM selected, one sees various requirements:

1) Data and address information must be at TTL compatable voltages.

2) For programming, 25 volts must be applied to pin 21 (V_{pp}).

3) Data and addresses must be held constant for 50 milli-seconds.

4) A certain timing sequence must be carried out with regards to the activation of the programming pin, pin 18 (See Timing Diagram.)

1) and 2) are easily met. The Z80 has TTL compatable voltage levels and four 6 volt batteries will provide 25 volts. 3) and 4) are harder to meet. A POKE command only holds address and data information on the busses for about 550 nanoseconds, almost 100,000 times too short for proper EPROM programming.

The solution is to use the $\overline{\text{WAIT}}$ pin on the Z80. When the $\overline{\text{WAIT}}$ pin is active (low voltage) all bus information is held constant until the pin voltage goes high again. The circuit shown has a one-shot whose time period is set to 50 microseconds. The other timing requirements are taken care of by the circuit as well, as explained next.

When the EPROM is addressed (a proper combination of A13, A14, and $\overline{\text{MRQ}}$, memory request) by the Z80, U1 switches the internal ROM off (via $\overline{O}_a$-pin 4) and turns on the EPROM (via $\overline{I}_a$-pin 5). If J1 is in, a $\overline{\text{WAIT}}$ state is started when $\overline{O}_b$ pin 12 of U1 goes low. At the same time, pin 13 $\overline{I}_b$ of U1 goes high initiating the 50 millisecond one-shot of U2 (VR1 + R2, C4). Q1 of U2 goes low for 50 milliseconds as does $\overline{\text{PGM}}$, pin 18 of U3, which then programs the EPROM. 2 milliseconds after the end of the 50 millisecond programming period, the second one-shot of U2 (R1, C5) disables the Enable pin, pin 15, of U1 thus clearing the $\overline{\text{WAIT}}$ state and allowing the computer to process the next instruction.

The design was such as to use a minimum of parts. Certain problems therefore exist which can be avoided by being aware of them. The main concern is that a PEEK command, or USR command into the EPROM when the EPROM is in the "program" mode will write useless data into the EPROM. Therefore, *do not* PEEK or USR into the EPROM without disconnecting the 25 volts (J4 out).

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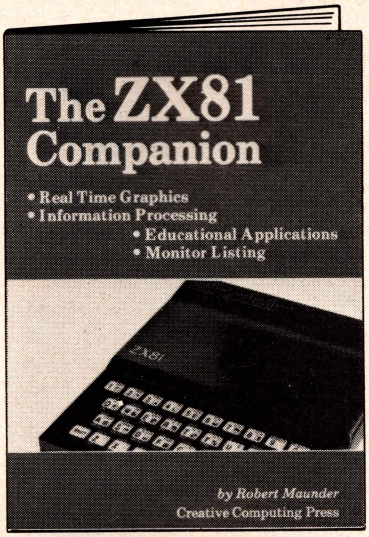

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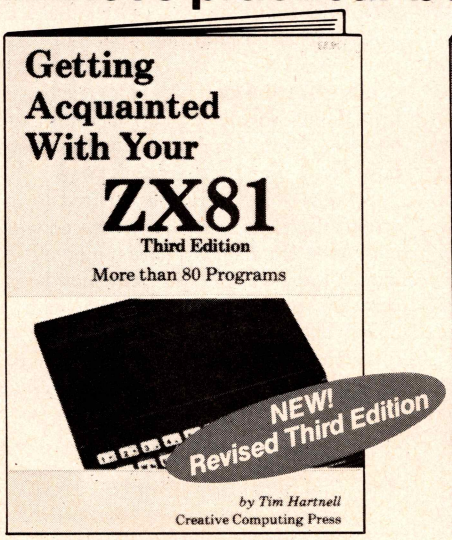

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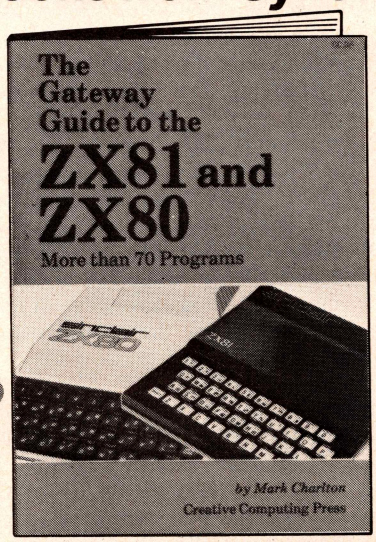

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If you are familiar with dynamic RAM specifications (the type of RAM used in the 16K-64K expansion units), you will know that they specify a maximum refresh period usually of 2 milliseconds. During a WAIT cycle there is no refreshing. So if the data sheets are to be believed, dynamic RAMs should not work with this EPROMer. However, I have found that dynamic RAMs can tolerate as much as one or two seconds without refresh and without loss of data. I have used my EPROM programmer with 16K and the newer 64K dynamic RAMs and have had no troubles. If you run into trouble, disconnect the dynamic RAMs and use the itnernal static RAMs, which need no refresh.

Making It

The construction method described here is the one I used and may not be best for you.

What I usually do is lay out the ICs (or IC sockets) on a board, making sure that there is enough room for miscellaneous components and that the wiring which will interface with the computer is conveniently close to the edge of the board. I seek to minimize runs, especially power runs (5 and 25 volt). I then put in the other components and use the leads as much as possible to wire the circuit. Every step of the way I check and double check that my wiring corresponds to the schematic. ICs get confusing since you must look at them from the top and the bottom. (See schematic.)

Many years ago I got a lot of color-coded telephone wire (what more could I want?) from an abandoned factory in my home town.

Program 1.

```
10 FOR L=0 TO 399
20 POKE 16000,0
30 NEXT L
```

Program 2.

```
10 FOR L=0 TO 4191
20 IF PEEK (L+12288)<255 THEN
PRINT L,PEEK (L+12288)
30 NEXT L
```

Program 3.

```
 5 IF INKEY$<>"P" THEN GOTO 5
10 POKE 16383,85
20 SAVE "P"
30 GOTO 20
```

Program 4.

```
SAME AS PROGRAM 2
```

Program 5.

```
 5 IF NOT INKEY$="P" THEN GOTO
5
10 POKE M,N1
20 POKE M+1,N2
30 POKE M+2,N3
.   (REST OF MACHINE LANGUAGE
.    PROGRAM)
.
.
1000 SAVE "P"
1010 GOTO 1000
```

Note: M = first address at which the data is to be put. N1, etc. is the data.

I use that to wire the rest of the circuit. I recheck the circuit against the schematic and then solder all the points. After that I use a Volt-Ohm Meter to test the continuity of each run as well as that two runs have not accidently shorted. Good, clean, logical construction habits save hours of needless trouble shooting later. I try to document what and how I have wired it after I am done.

So now you have a board wired as in the schematic. Next it must be interfaced with the computer. Here again I used a method which may not be right for you. Any method is acceptable, including hardwiring it with color coded telephone wire. However, this could limit future expansion. AP Products (as shown on page 42 of the 1982 Jameco Catalog) has jumper headers and cable assemblies which can be used. I used two straight double row, 40 post jumper headers. One set I soldered onto the EPROM board. The other set I soldered onto the computer's edge connector lower forty.

I then interconnected the two boards with a 6" AP flat ribbon cable. Long runs of data lines can cause problems and should be avoided. Of the four remaining edge connector positions, only two are needed: D_7 and 5 + volts. These I hard wired with a connector in between for disconnecting.

The EPROM is a MOS device and is susceptible to damage due to static discharge. I have not been overly cautious, yet I have never had trouble with static charge destroying a

Figure 4. Parts List.

Part.		Radio Shack Number. (If more than one of item in package, then number is listed only the number of times needed.)
	ICs	
U1	74LS139	** (See below)
U2	74Ls123	**
U3	TMS 2532, 450 ns.	**
	Resistors	
R1	10K	271-034
R2	100K	271-045
R3	1.8K	271-1324
R4	1.8K	
R5	1.8K	
R6	3.3, ½ watt (optional)	271-028
	Capacitors	
C1	.1 mfd	272-1069
C2	.005 mfd	272-130
C3	.1 mfd	
C4	1 mfd	272-1419
C5	470 pfd	272-125
C6	.005 mfd	
C7	33 mfd, 16V.	272-1426
	Diodes	
D1	Diode	276-1101
D2	Diode	
D3	LED (optional)	Various available
	Variable Resistors	
VR1	25K	
	Miscellaneous	
J1, J4	Jumpers or one way switches	Any suitable
J2-3,	3-post jumper or 2-way switch	Any suitable
PC Board		276-153
IC socket for U3 - 24 pin*		276-1989
Batteries	(4) - 6 volt lantern	Eveready 509 or equal
Connector Cable	(See article "Making It")	

* The other IC's can be soldered into place without too much fear of damage or having to replace them. But the EPROM, and any MOS device, really should be in a socket.

** Available through many mail order houses, such as Jameco, Active Electronics, JDR Microdevices, etc., Addresses and prices can be found in the back of most hobby electronics magazines.

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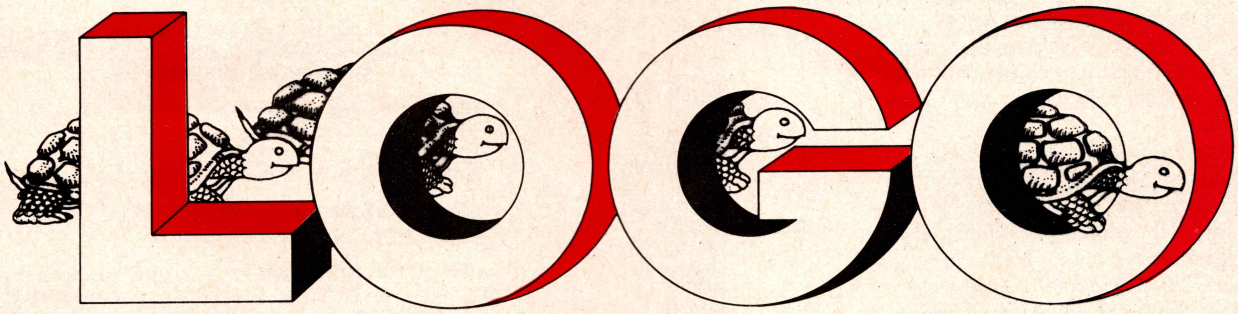

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MOS device. One should, however, make sure before handling the EPROM that you are discharged to the ground of the computer board. Do not place EPROM into socket until both the timing and the 25v circuit have been checked out.

In making the EPROM programmer I ran into difficulties. The main one was that the EPROM pin (address 7) was defective and only one half of the memory was addressable. At first I assumed that my circuit was in error. After several days I convinced myself that the EPROM was bad and returned it for exchange and bought another chip as well. The exchanged chip had the same problem while the new chip appears to be working fine. (I also accidently applied 25v to the 5v supply which fried 2 RAMS but in the process fortunately spared the rest of the computer.)

Trouble Shooting Before Putting the EPROM In

In *SYNC* (2:1) I showed a method of monitoring computer activities by injecting signals into the video output. This method is useful in dynamically testing the board and connection to the computer. With the computer on and the board connected, note the different patterns that the pins on the Z80 make relevant to the EPROM. For instance, the patterns for A_0 at the edge connector should be the same as A_0 at the EPROM.

Program 6. A Machine Language Program to be POKEd into the EPROM.

```
            LD HL  (E-file)     ;  Load HL with E-file location the end
                                   of the variables list.  A string must
                                   be at the end of that list.
            EX HL,DE
            LD H, B             ;Clear HL for addition
            LD L, B
NEXT:       DEC DE
            LD A,(DE)           ;See if it's a variable name
            CMP , 129
            JRC -NEXT           ;If not check next byte
AGAIN:      INC DE
            LD A, (DE)
            CMP , Ø1            ;If quote token (Ø1) then you're done and
            RETZ                ;you'll return to the BASIC program with
            ADD HL              ;the number in HL.  USR returns HL to the
            ADD HL              ;program.
            ADD HL              ;Shift HL four places: 16 times.
            ADD HL
            SUB, 28             ;Convert letter to number
            JRC, +ERROR         ;Error if string token less than Ø
            CMP, 16             ;See if token is greater than "f"
            JRC +NO ERROR       ;If not, jump to NO ERROR
ERROR:      RST Ø8 , 9          ;ERROR ends BASIC program with ERROR code "A"
NO ERROR:   LD C,A
            ADD HL,BC           ;Add converted token to HL
            JR AGAIN            ;Do again
```

Decimal listing for Program 6.

```
 0-42    1-10    2-64    3-235   4-96
 5-104   6-27    7-26    8-254   9-129
10-56   11-250  12-19   13-26   14-254
15-01   16-200  17-41   18-41   19-41
20-41   21-214  22-28   23-56   24-4
25-254  26-16   27-56   28-2    29-207
30-9    31-79   32-9    33-24   34-233
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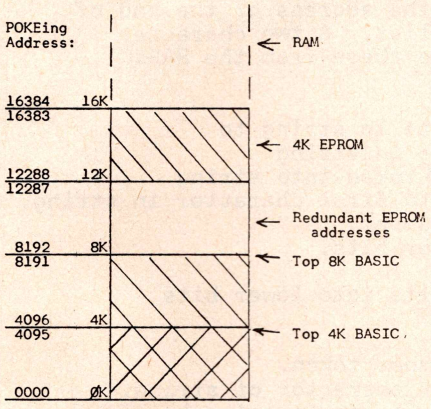
Chart 1.

MODE:	J1	J2	J3	J4
Test	in	out	in	out
Program	in	out	in	in
Read	out	in	out	out

Chart 2. Memory Locations.



The microprocessor starts at zero and proceeds up in addresses, doing each instruction in turn until it eventually loops back to a lower address.

Repeat for A_0 to A_{11} and D_0 to D_7 as well. Make sure that there are five volts where there should be on the board. If all looks good, then you are ready to check the timing circuit.

Program 1 will allow you to set VR1 for timing the one-shot. First, put the programmer into the test mode (see Chart 1). Then run the program. It should take as close to 20 seconds to run as you can measure. Adjust VR1 until the program takes 20 seconds. If you cannot adjust the programmer to 20 seconds, then R may be changed, lower value to make it faster, higher value to slow it down.

Applying the 25 Volts

The 8K user should read the next section before going further.

Since the 25v can be so damaging, triple check that the 25v line only runs to pin 21 of the EPROM and that the diode is in properly and works properly. Then turn the power off.

Put the EPROM in, turn the power back on, and RUN Program 2. If Program 2 ran badly, go back and check the wiring. If it ran okay, then RUN Program 3. (4K ROM apply 25v before RUNning the program; 8K ROM, during the run.) After the program is over and the 25v are removed, run Program 4. Program 4 checks to see that your wiring has not created redundant addressing in the memory. If the program prints more than one address, then most likely an address line is open (or the EPROM has a defective address pin), and you must go back to the previous section and dynamically check the address and data lines. If program ran okay, then you are ready to program the EPROM with real data.

Verify that when the 25v are connected to the Vpp that only 3 to 30 ma are drawn by that pin. Also, if some other 25v source is used, make sure it is well regulated to within + 1v of 25v.

Programming the EPROM

Programming is simple. Put the Eprom programmer into the program mode (Chart 1) and then POKE data into the EPROM addresses. Because of the way the 8K ROM uses the Refresh cycle, I have had trouble on occasion while the video is on. Therefore, for the 8K ROM the video must be "off" while the EPROM programmer is in the program mode. Program 5 is used for the 8K ROM. Do not have the 25v on when the 8K ROM video is

Program 7. Entering Hexadecimal Data.

```
10 FOR L=0 TO 19
20 PRINT L;"-";
30 INPUT I$
40 PRINT I$
50 POKE L+M,USR N
60 NEXT L
```

Note: M = first address to which data is to be POKEd. N = address of Program 6 in the EPROM. This program *cannot* be used to POKE into the EPROM.

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on, or else bad data may be written into the EPROM. Line 5 of the program is a loop which waits for the "P" key to be pressed. While the program is waiting, you must set the EPROM programmer to the "program" mode. Then press "P" and the program will POKE the data into the EPROM. You will know that the programming is done when the screen starts to gitter with garbage as the program gets SAVEd in line 1000. Now place the EPROMer into the "read" mode. Then press BREAK.

Two sample programs are shown which work for the 4K Basic. One converts a hexidecimal string into a number (Program 6). The other program converts a number into a hexidecimal representation which can be PRINTed (Program 8). Programs 7 and 9 show their uses in Basic programs.

Putting It to Work

This construction project is really an open ended affair, just as computers are. Once operating, your limits are your imagination, patience, and money. Though not particularly difficult to build, like all projects it will take fortitude to keep on going when things look hopeless (and they will).

Published programs should be checked to see if any changes must be made when relocating them to the EPROM addresses. Relative jumps and calls to inside the program have to be changed. An example of one particular problem is illustrated by trying to adapt the

Program 8. A Machine Language Program to be POKEd into the EPROM.

```
LD HL,(VARS)          ;Load HL with location of first Variable.
                      ;Variable must be there from BASIC
                      ;program and must be a one letter name.
INC HL                ;Get past variable name.
LD A, (HL)
LD B, A
AND A, ØF h           ;Mask last four bits
ADD A, 28             ;Convert to number token
LD HL, (E-file)       ;Load HL with the address of the end of
                      ;the variable list.  A two character
                      ;string must be there from the BASIC
                      ;program.
DEC HL
DEC HL                ;Move past quote in string to
DEC HL                ;last charactor in string
LD (HL), A            ;Load converted token into string
DEC HL                ;Move pointer to first charactor in string.
LD B, A               ;Get rest of number.
AND A,FØ h            ;Mask upper four bits.
RR
RR                    ;Shift upper bits into lower bits
RR
RR
ADD A, 28             ;Convert to number token.
LD(HL), A             ;Place in upper charactor of string.
LD HL,ØØØØ            ;Clear HL just for neatness' sake.
RET                   ;Return to BASIC with the last string
                      ;being a hexidecimal representation
                      ;of the number in the first variable.
                      ;Note:  Only numbers Ø to 255 are converted.
```


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"Scroll" routine of Logan (*SYNC* 1:4). The routine requires three bytes of RAM, one to pass the "Leave" parameter, the other two for an internal program register. The addresses of the RAM bytes were immediately before the subroutine. Obviously, an EPROM can not be used for RAM. My solution was to pass the "Leave" parameter through the RANDOMISE command and use the Syntax pointer location for the INTERNAL PROGRAM register since no Syntax pointing is required during the subroutine.

There have been many good subroutines in *SYNC* and the general techniques outlined in such articles can be used as long as they are not used blindly but understood and modified as needed. A good book on Z80 machine language programming will help a great deal.

A log of the addresses should be kept so that you know where what is and that you do not over write onto existing programs. Also tape copies of all programs should be kept in case it becomes necessary to reprogram the whole EPROM.

I have run my programmer with the power supply provided with the computer. However, when I started to add other devices, it quickly became necessary to supplement the power supply. If your system is already taxing the power supply, you will have to consider expanding it.

Construction Outline

1) Gather parts into one place and fit them into the PC board. Use the IC socket for the EPROM.

2) Solder the circuit together.

3) Test the board for proper connections.

4) Check and adjust the timing resistor. Check the 25v line.

5) Place the EPROM in and test it with the various programs (2 through 4).

6) If it is okay, program in some simple routines and see if they work.

References

The MOS Memory Data Book, Texas Instruments, 1980.

NEC Microcomputers 1981 Catalog. (For Z80 timing data.)

The Art of Electronics, Horowitz and Hill (A good book on electronics in general.)

**Microprocessor Interfacing Techniques,* Zaks and Lesea. (A bit dated, especially on LSI support ICs, but good on timeless things like the S-100 Bus, basics, etc.)

**How to Program the Z-80,* Zaks. (A standard book on Machine language programming the Z80.)

*Recommended for working with this project.

Decimal listing for Program 8.

```
0-42    1-8     2-64    3-35    4-126
5-71    6-230   7-15    8-198   9-28
10-42   11-10   12-64   13-43   14-43
15-43   16-119  17-43   18-120  19-230
20-240  21-15   22-15   23-15   24-15
25-198  26-28   27-119  28-33   29-Ø
30-Ø    31-201
```

Program 9. Display of Data as Hexadecimal Numbers.

```
 5 LET X=0
10 FOR L=0 TO 19
20 LET X=PEEK (L+M)
30 LET I$="XX"
40 LET X=USR N
50 PRINT L;"-";I$,
60 NEXT L
```

Note: Line 5 reserves the first variable in the variable list for the subroutine. This must be done before the FOR command sets up its variable. The FOR variable cannot be used for the first variable, nor can variables with more than one character in the name. Line 30 makes sure that there is a two character string at the end of the variables list. M = first address of the area to be displayed. N = address of Program 8 in the EPROM.

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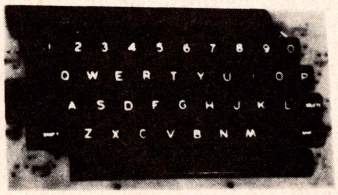

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Ed.- **A WORD OF CAUTION:** *Any hardware project for your computer must be approached with extreme caution.* **SYNC** *cannot be responsible for any problem that may arise from attempting hardware projects. Obviously, any damage to your computer can be costly in time and money.*

hardware tips

Strong KBD Signals Again

Stephen G. Turner

The Hardware Tips in *SYNC* 2:4 regarding strong signals on KBD 0 to KBD 4 came at a time when I had some missing shifted functions so I decided to try the solution. However, I did not want to attempt to remove RP3 which would probably involve crushing the pack and unsoldering the wires one at a time. Instead, using the formula

$$R\,t = 8.6K = \frac{R_1\,R_2}{R_1 + R_2}$$

where R1 is the resistor pack value, I decided to wire parallel 62K = R2 resistors on the underside of the board as shown in Figure 1.

All of my keyboard functions now work. So Herb Hornung has a right answer.

A further aspect of the problem involves the RP3 itself. Through correspondence with Sinclair, I found that the RP3 may be installed backwards. This would cause 20K instead of 10K to be at four of the five keyboard connectors. This would cause many of the upper case functions not to work. The correct orientation of the RP3 pack is with the lettering away from the keyboard connectors.

You can solve this problem in either of two ways. 1) Remove the RP3 and install a new one in the correct direction (with the lettering away from the connectors). 2) Use the underside of the board to parallel the four positions of high resistance with 20K resistors. See Figure 2.

I also learned that the incorrect installation of the RP1 (the correct orientation is with the lettering toward the Z80A) will cause the 16K RAM pack not to work. This is the same case only with RP1 installed backwards.

Stephen G. Turner, 6438 S.E. Division St., Portland, OR 97206.

Figure 1.

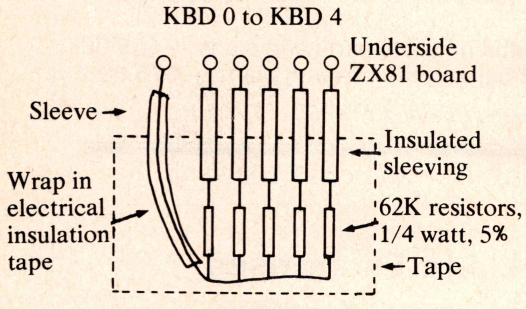
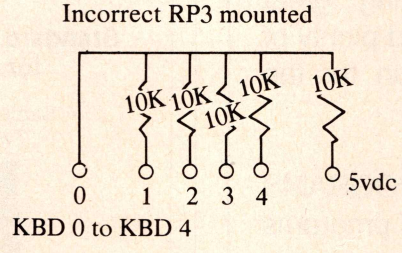
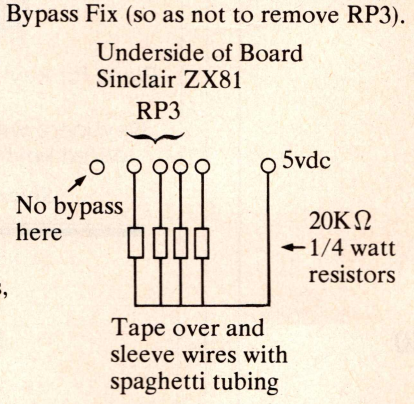


Figure 2.





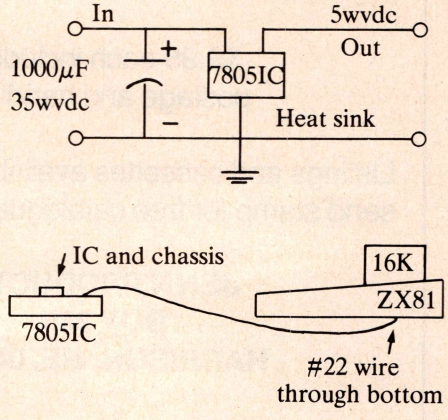
Overheating Problems

Stephen G. Turner

My ZX81 with 16K RAM suffers the heating problems typical of this combination: disappearing cursor, total crash (loss of video), "wait state" (keyboard will not respond); and blurry display. Generally, at any of these states, the 7805 heat sink could toast muffins.

My solution was to remove the 7805IC and to mount it externally on a chassis box with a 1000uF, 35wvdc cap on the input side to clear up the screen interference. I used #22 wires from the chassis box through the ZX81 grill holes to the IC connecting points. This solved the problems.

Users of the Sinclair will have to be realistic that overheating is a culprit of system failures. Since the Sinclair is a tremendous unit for the price, it is worth fixing the heating problem.



RAM Expansion Problems

Tom Keeney

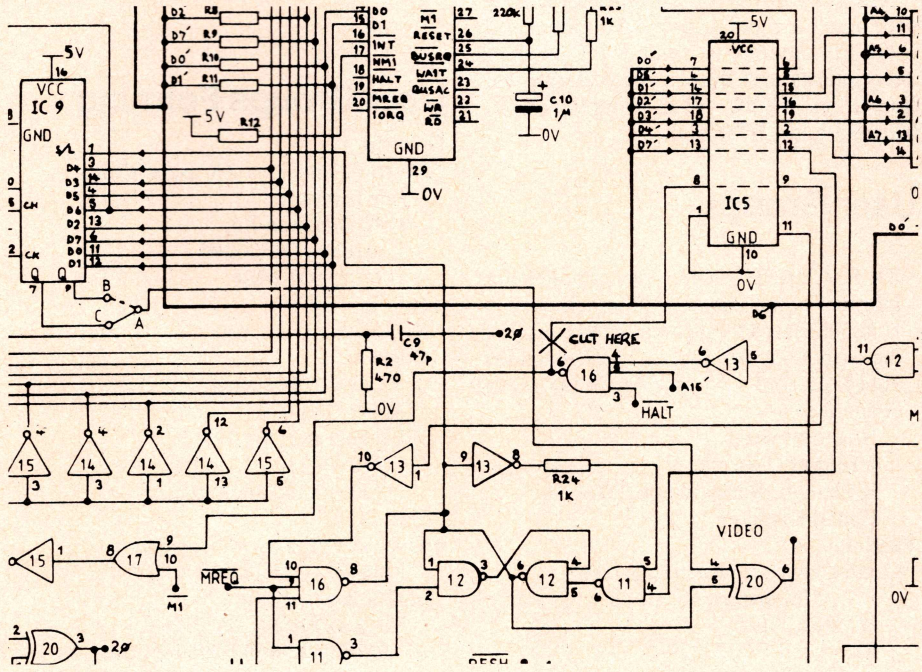
ZX80 owners attempting to upgrade their computer memory past address location 32767 may have display problems unless they make a circuit modification. The problem becomes apparent when RAMTOP is moved past the 32K boundary and will manifest itself by the presence of black dots in the screen margins. Those who have installed MicroAce Video Upgrades will get a special treat: the dots will actually move across the margins in an orderly fashion, like a drill team of ants! This will happen anytime a key is pressed or during any computation.

The problem is caused by the fact that the contents of the data bus are sometimes shifted into the video when addresses above 32767 are accessed.

The cure is to add the M1 (instruction fetch) condition to the video shift signal generation logic. As indicated in Figure 1, this is done by cutting the board trace between IC5 pin 8 and IC16 pin 6 and installing a jumper between IC5 pin 8 and IC17 pin 8. Care should be exercised in making the board cut because it is easy to accidentally cut the connection between IC16 and IC17.

Tom Keeney, 9629 Dortmund Dr., Huntsville, AL 35803.

Figure 1.



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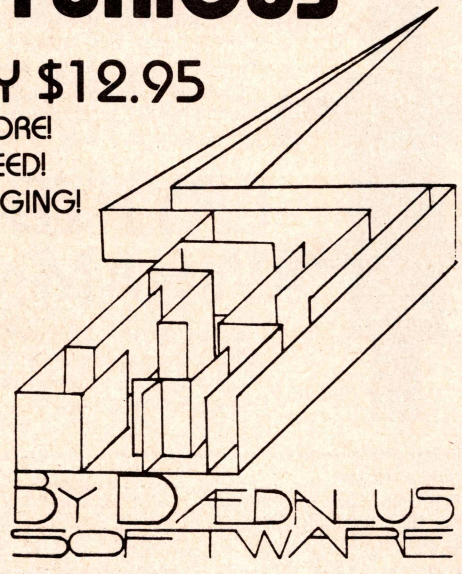

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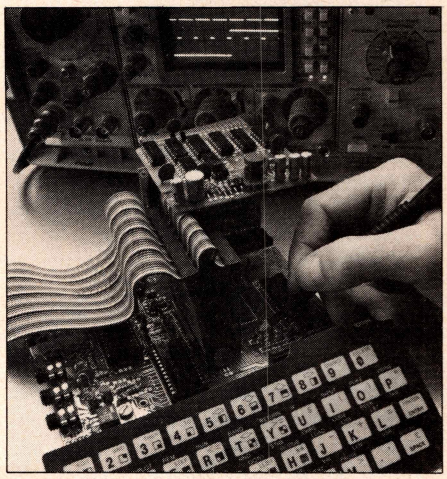

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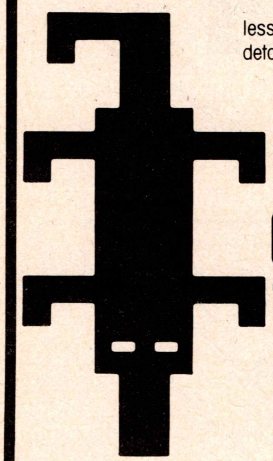

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letter from en

Stephen Adams

One of the advantages of living in England, Home of Sinclair Research, is that we get to try out some of the "extras" before anyone else. Here are some of the things that may cross the Atlantic from England for the ZX81.

An exciting new development for the ZX81 enthusiast is an alternative keyboard to replace the "touch," but not very sensitive keyboard. There have been a lot of complaints on this side of the water that the keyboard is slow and difficult to use because of the lack of "moving keys." This new "KLICK" keyboard from Kempston Electronics (60 Adamson Court, Hillgrounds Road, Kempston, Bedford, England) is the same size as the Sinclair, but 1 cm taller. The keys are made out of proper keyboard switches and have the appropriate legends stuck on top. The layout of the keys is also the same, and there is even space for a repeat key. The keys move under your fingers, and it is very light and easy to use. Connection to the ZX81 is made by plugging two plastic cables into the keyboard sockets instead of the Sinclair keyboard. The Sinclair keyboard has to be first removed by peeling it back (it is only a few millimetres thick) and then after undoing the screws on the base removing the keyboard "tails" from the sockets. The result is beautiful to look at as well, as it is finished in black to match the computer. The cost including U.K. VAT at 15% is £27.20.

The same firm also has a keyboard beeper and repeat key modules which fit inside the computer under the keyboard.

A keyboard beeper that does not require any soldering at all is made by Fulcrum Products (Hillside, Steep lane, Findon, Worthing, West Sussex, England). This comprises a printed circuit board which is small enough to fit inside the ZX81/Timex underneath the keyboard or even under the computer's own printed circuit board. The hole connections within the computer are made by inserting spring clips into the holes which are already plated to carry the circuit from one side of the board to the other.

The connections to the keyboard are done by removing the keyboard "tail" from the socket on the computer board (only one has to be moved) on to an identical socket on the beeper. A keyboard strip containing the same sort of metal strips is then plugged into both the keyboard socket and the beeper. This is all the connection required. It can be easily removed if the computer has to be sent back for repair.

It beeps whenever a key is pressed including all the modes (G, F, L, and K). It also works on all the keys when the SHIFT key is held down. It is a very good method of making sure that the computer has registered the key press on Sinclair's thin keyboard. The cost of the board is £8.95 including VAT.

While we are on the subject of solderless additions, how about a RAM board which fits inside the ZX81 via a set of screws (no RAM pack wobble here) and can have up to 16K of semistatic memory on it? The board is called the INCREMENTAL RAM board and is made by East London Robotics (Finlandia House, 14 Darwell Close, London E6 4BT). The board costs £13.23 for the 16K board and £4.93 for each extra 2K of memory required (one plug-in chip).

The board uses CMOS 6116 RAM chips which can be purchased in the USA. Being semistatic CMOS they take less power than 16K dynamic RAMs and can be powered by batteries to keep a program intact when not in use. They are also more reliable than dynamic RAMs which rely on the REFRESH signal. The increment board is easy to fit with brass screws through the plated holes on the printed circuit board to make the connections. It can even be removed with no trace when sending the computer back for repair. There is also the advantage of not having a wobbling RAM pack blocking up the expansion port.

If, however, you decide later that you want to use more memory, the increment RAM can be moved to any position in memory to give increased Basic memory from 32K upwards or from 8K upwards for running machine code programs in, etc.

Another basic problem with the Sinclair/Timex is the amount of glare that you can get using an all white screen. Most computers work in reverse to the Sinclair and PRINT on a black background, thus saving eye strain. Now a device is available from D. Fritsh (6

Stephen Adams, 1 Leswin Rd., London N16 7NL, United Kingdom.

gland

Stanton Road, Thelwall Warrington, Cheshire, England) which will reverse the TV screen at the flick of a switch. This inverse video module (£7.50) sits on top of the ULA chip inside the computer, stuck there by a piece of sticky tape. The only connections required are to the video lead and to the power (+5v and 0v). The switch is already wired up.

The instructions are superb, and they even include a template for drilling the hole for the switch. An added bonus is that it improves the "crispness" of the display and stops graphics, for instance, from looking fuzzy.

If I seem to be a hardware fiend, it is only because the best programs over here are in machine code and some of them will not operate in the USA without modification. This is because they do not use the Sinclair ROM routines to put out the TV picture, but write their own in order to get fast graphics. The TV system over here is 625 lines PAL on the UHF band. The USA frequency is VHF NTSC 525 lines and is totally uncompatible.

One of the programs in Basic that I have is a word processor by Asher & Kuehn (60 St. Lenonards Gardens, Heston, Middx, England) with two forms called ZTEXT and LTEXT. ZTEXT provides only CAPITAL letters while LTEXT gives both CAPITAL and lower case letters on the printer. Both are on the same cassette for £6.

There are two modes: write text T and edit text, the second giving all the functions of insertion, deletion of lines of text, searching for a specified word or phrase, replacing the found word with another or printing it out on a Sinclair printer. Also it can be used to "mail merge" letters by indicating on the standard letter where words should be different on each letter (Name, Address, etc.). The program then stops to allow you to insert these details and ENTER will carry on the printing. The number of variations of setting the page width, number of lines, tab, and other formatting commands are available as a dot followed by the code letters. It is very good, given the restrictions of a 32 character screen, but does not have the ability (in the case of LTEXT) to display lower case or all the punctuation marks. These are usually indicated by INVERSE characters on the screen. Altering the program to use a real printer can be done. ■

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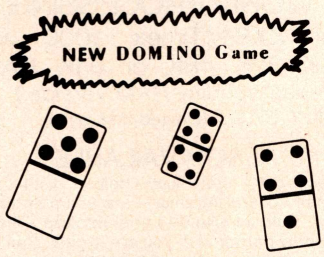

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Peter D. Hoffman

The QSAVE package consists of: 1) a hardware unit, 2) a software program, and 3) an instruction booklet. It performs tape SAVE, LOAD, and verify at 4000 BAUD.

The hardware box has two standard phono plug connections for feed-through of the 9v power supply and two for connecting the recorder output and computer input. Described as a filter, a two stage amplifier, and a signal shaper, this unit is used only during LOADing to condition the signal from the recorder to the computer.

The actual circuit design is simple but elegant. A four stage op amp chip is used along with a timing chip for voltage doubling. Two stages of the amplifier give a mild gain and the other two stages are arranged as high and low filters. Clipping diodes provide the square wave signal shaping. The circuit board and overall construction show a quality level of wokmanship. The current draw was measured at 17ma.

The software program runs the Basic portion automatically after LOADing and relocates the machine code program above RAMTOP at address 32000. USR calls access the SAVE, LOAD and verify functions.

The verify function checks on whether the program has been saved properly by calculating a simple checksum of the bytes and then recording this value at the end of the tape. During verify the tape is read (but not LOADed to memory), the checksum is calculated and compared to the checksum recorded on the tape. It does not make a byte-by-byte comparison with the program still in the computer, nor does it make any use of the program in memory. If the verify does not work, you perform the SAVE operation again.

The QSAVE program must be LOADed each time the computer is powered up or reset. This is a nuisance and could interfere with other programs using the protected USR area above RAMTOP, as more and more programs seem to be doing. The QSAVE code could be put in an EPROM or nonvolatile memory in the 8K-16K address space.

The program SAVE/LOADs the entire 16K of RAM everytime. This takes 25-30 seconds. The program could be made capable of loading just up to E-LINE as the Sinclair software does. Since the SAVE/LOAD actually starts at address 16301 and goes to 32896, the user might have problems with RAM at addresses just below 16K and just above 32K. Finally, by POKEing in the proper values, the program could save a full 48K of user RAM in less than 1½ minutes.

A BREAK key capability would be helpful since the program would hang up in the machine code during the search for the proper recorder volume.

Peter D. Hoffman, 5618 Martinique Dr., Corpus Christi, TX 78411.

SYNC

SOFTWARE PROFILE

Name: QSAVE

Type: Tape Facility

System: 8K ROM; 16K RAM

Format: Cassette; hardware

Summary: An inexpensive alternative that gives very reasonable LOADing times.

Price: $37.50

Manufacturer:

Personal Software Services
112 Oliver St.
Coventry CV6 5FE
United Kingdom

The software shows some evidence of having been rushed to the market without a final cleanup. For instance, the machine code program has some extraneous code that is never used. The machine code for LOADing the program above RAMTOP appears to test for old vs. new ROM and make the necessary changes to allow a call to ROM for the FAST routine by the old ROM. But, in fact, the old ROM capability is not there. The machine code also puts the computer in FAST mode and then leaves it there. A corresponding switch back to the SLOW mode before returning from the machine code program would be useful.

The key to understanding how this program works (and, to an extent, the Sinclair SAVE and LOAD procedures) is the fact that the bits are represented by the length of the silences on the tape. The machine code program listens for and measures the length of the silences. The tone bursts on the tape are nothing more than separators of the silences. This puts a

premium on having good quality tape with low inherent background noise and a good erase head.

Also similar to the Sinclair tape procedures, the BAUD rate for the data transfer is variable depending on the mix of 0 and 1 bits. On the Sinclair the BAUD rate is 5600 if all 0 bits are being transferred and 3000 if all 1 bits are being transferred. Since in QSAVE each bit is a single silence separated by tone bursts, the apparent audio frequency is the same — 5600 Hz and 3000 Hz. This is probably pushing the limits of frequency response of inexpensive recorders that are intended for voice recording only. The 4000 BAUD is an average value only.

I then performed a series of experiments with several recorders and the QSAVE package. The first was a bottom-of-the-line GE that had been resurrected from the dusty depths of a closet and used from the time the computer was purchased. After detuning the software program to 2000 BAUD by POKEing new values into the delay loops, the QSAVE package would work with this recorder. This detuning lowers the apparent audio frequencies by half. Even so the volume setting was very touchy.

A second recorder of unknown history and condition could not be made to work with either the original 4000 BAUD version or the detuned 2000 BAUD version.

The third recorder was a nearly new top-of-the-line Sony. The QSAVE package worked at 4000 BAUD. Furthermore, the volume setting was almost irrelevent. Reliable LOADing was obtained at any volume setting from ¼ to full volume.

Lastly, another Sony identical to the third recorder was tried. It had seen heavy recording usage and would not even load the standard Sinclair tapes. After the worn record/playback head was replaced, it performed as well as the new model.

These experiments suggest that fairly good recording equipment is required to use the QSAVE package. Since the silences on the tape are critical, frequency response and reasonable signal-to-noise ratio by the playback head are needed. None of the recorders had a tone control. The instruction booklet indicates that a half setting on the tone control can reduce the sensitivity of the volume setting.

In conclusion, QSAVE is an interesting package. It does perform as advertised when used with good quality recording equipment, but there is room for improvement to a fine product. I plan to wire the QSAVE hardware into a new computer case (my current project) and to put the machine code program in non-volatile memory below 16K. Unless and until a reasonably priced disk drive is available for the ZX81, this package is an inexpensive alternative that gives very reasonable LOADing times compared to the normal Sinclair tape operations.

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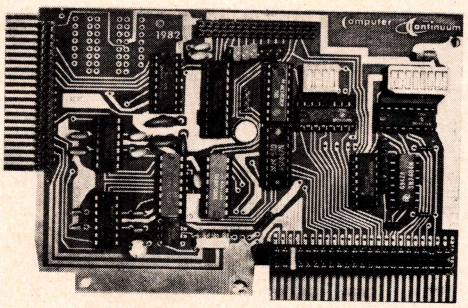

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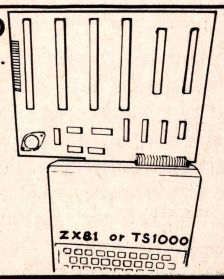

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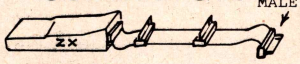

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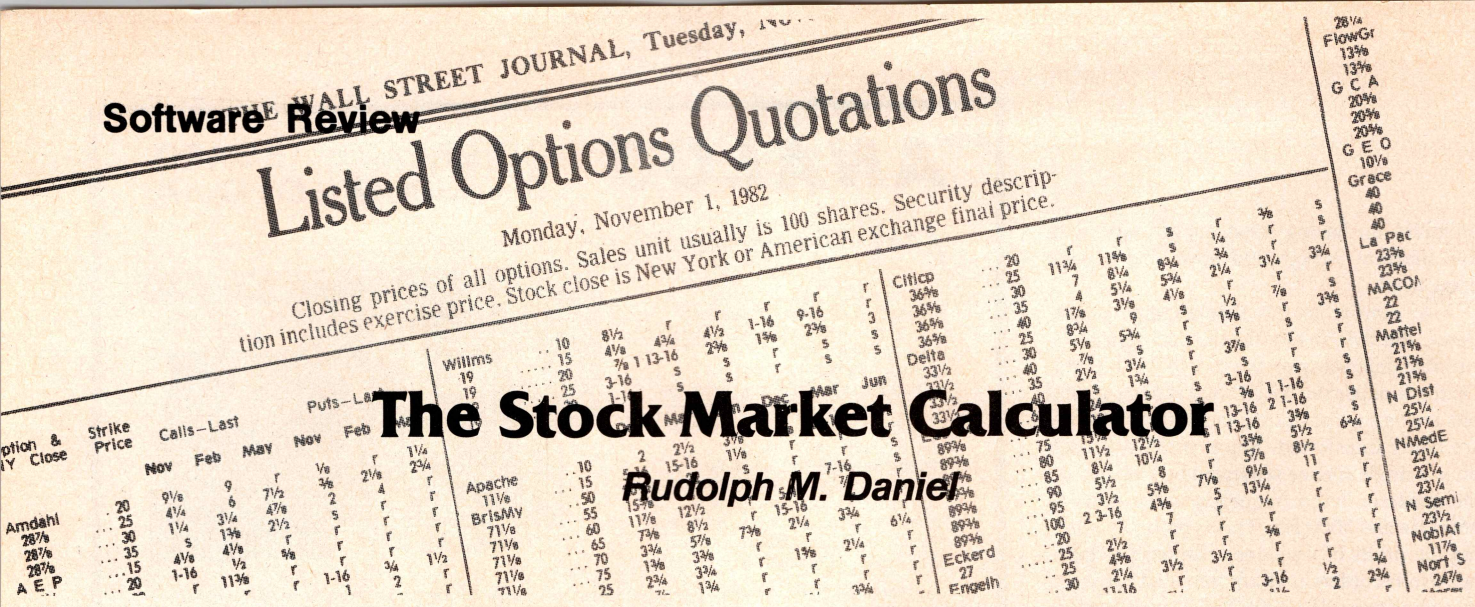
THE WALL STREET JOURNAL, Tuesday,

Listed Options Quotations

Monday, November 1, 1982

Closing prices of all options. Sales unit usually is 100 shares. Security description includes exercise price. Stock close is New York or American exchange final price.

The Stock Market Calculator

Rudolph M. Daniel

How many times in glancing through a newspaper have you noticed a listing of current stock prices? Some of us might feel awed by the pages of strange symbols and numbers, while the professionals are probably spending needless hours performing the tedious caluclations required to analyze this information. To aid these frustrated individuals, SOFTSYNC, Inc., has created a software package called *The Stock Market Calculator*, appropriately named because its primary function is to help the investor (or user) solve the complex equations inherent in Investment Analysis.

The entire package consists of two programs. The first is divided into three sections:

(1) Net Price Worksheet
(2) Profit/Loss
(3) Covered writes

The first section (Net Price Worksheet) derives the buy and sell prices along with their respective commission. This calculated commission should be used as an approximation of the actual commission because these charges tend to vary with each brokerage house. However, figures calculated by the program should be "extremely close" to the charges at most major houses. (A better idea would have been to make the rates variable in accordance to user needs.)

The second section (Profit/Loss is as useful to the seasoned investor as it would be to the armchair speculator. Learning the "bottom line" of a finan-

Rudolph M. Daniel, 67 Manhattan Ave., Brooklyn, NY 11206.

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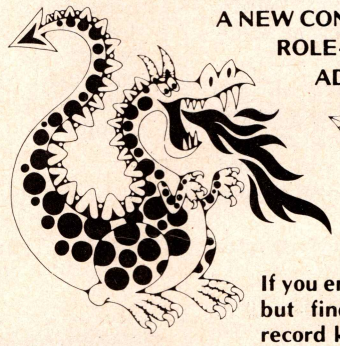

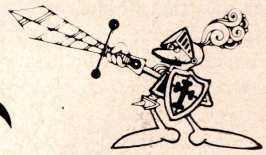

If you enjoy role-playing games, but find the dice-rolling and record keeping a drag, let your ZX81 or TS1000 take over these chores. GameMaster for 16K RAM lets you create characters and monsters, use them during play, and then save them on tape. It also speeds combat and provides many other features. The 1K version provides automated dice rolls, eliminating the need for expensive adventure game dice.

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cial transaction is crucial to all individuals. E.g. If you were to buy 100 shares of stock at a price of $23 per share and sell the same stock at a price of $27 per share, the result calculated by the program would appear as follows (See Figure 1).

Both of the previously mentioned sections can be used as a learning tool for the novice investor or student interested in seeing commission charge fluctuations and profit/loss figures for varying size transactions of stocks or contracts, particularly because of the speed of the program.

Figure 1.

```
 BUY 100 SHARES AT 23
SELL 100 SHARES AT 27

COMMISSION:
ON PURCH $61.08
ON SALE  $67.37

NET DOLLARS:
ON PURCH $2361.08
ON SALE  $2632.63

PROFIT:
$271.55 (11.5 PCT)

■ PRESS ANY KEY
```

SOFTWARE PROFILE

Name: The Stock Market Calculator

Type: Financial

System: 8K ROM; 16K RAM

Format: Cassette

Summary: Excellent documentation; fairly well-written programs; something for everyone.

Price: $14.95

Manufacturer:

Softsync, Inc.
14 East 34th St.
New York, NY 10016

Again the resulting profit or loss will vary slightly due to the approximated commission rate, but consequently the total calculating time by the program was under 2 seconds.

The third section (covered writes) is a bit more complicated and basically geared towards the investors familiar with different market hedging strategies and the concept of call options. E.g. see Figure 2 and 3.

The right side of Figure 2 represents the information required to calculate the appropriate "cover" for a specified position.

NOTE: You can only cover buys of "round lots" (multiples of 100). This is because 1 call contract fully covers 100 shares of stock. The resulting output (Figure 3) does return to you a surplus of important information concerning the factors involved in covering your desired position. And at this point, previously defined variables (from Figure 2) can be altered and the results recalculated. Total calculating time for this section is under 5 seconds.

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The second program on this tape repeats the Net Price Worksheet and adds a section called the "Write Unwrapper." This section can be considered complementary to the Covered Writes section in the previous program. In this section you input your past "covered" position and the program outputs your financial position if you were to sell your stocks and repurchase your previously written calls. Total caluclating time for this section is again under 5 seconds.

Figure 2.

```
** COVERED WRITING WORKSHEET **

ENTER THE FOLLOWING DATA:

CURRENT DATE -MONTH          11
             -DAY            30
             -YEAR           82
STOCK SYMBOL                 IBM
STOCK PRICE                  56
NUMBER OF SHARES             200
ANNUAL DIVIDEND/SHARE        8
NBR OF PMNTS EXPECTED        4
OPTION EXP MONTH             FEB
OPTION STRIKE PRICE          58
OPTION MARKET PRICE          2
MARGIN INTEREST RATE         17
```

Figure 3.

```
*** COVERED CALL WORKSHEET ***
          11/30/82

BUY 200  IBM AT 56          YLD -14
.3
 SELL 2  FEB 58 CALLS AT 2
  DEBIT 54      DAYS TO EXP 87
        MGN RATE 17

          ** CASH **
   CAPITAL REQUIRED $11020.33
EXERCISED RTN 18.11   ANN 75.98
SAME PRICE RTN 16.15  ANN 67.76
  BREAKEVEN PRICE/SHARE $47.1

          ** MARGIN **
   CAPITAL REQUIRED $5328.33
EXERCISED RTN 33.13   ANN 138.99
SAME PRICE RTN 29.07  ANN 121.96
  BREAKEVEN PRICE/SHARE $48.25
```

Besides the fairly well-written programs contained in this package, users will find that the documentation is also excellent. You are given definitions of terms used and data by which to check computer calculations. This is one of the most important points to consider when purchasing software, and one of the reasons why the *Stock Market Calculator* has something for everyone. R.M.D.

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The ZX Data-Finder

James P. Cripps

The ZX Data-Finder is one of quite a variety of data handling programs now available. Typical uses for such programs include: names & addresses; inventory catalogues; customer/client records; graphic charts; product descriptions; statistics; appointment calendar; personnel files; hobby collection/ with cross referencing. ZX Data-Finder does these and more because the flexibility of the program lends itself readily to a wide variety of applications.

Files can be added as needed and are set up simply by assigning names. By assigning the same name to files it is possible to extend each file to the limits of user memory. For example, my "phone" file has eight screens full of numbers. In addition I have a file set up for each of the coming six months. Each file contains appointments, anniversaries, birthdays as well as reminders of upcoming events or obligations for that particular month.

Individual file length is not preset but can expand or contract as items are added or deleted. The maximum length of each file is fourteen lines (the total display area). The remaining lines are devoted to providing the program options available to the user.

Functions include: "ADD" for creating new file headings; "EDIT" for adding, altering, or deleting lines of existing files. The ADD/EDIT mode incorporates a moveable blinking cursor to select the desired line for editing.

The DATA-SEARCH/DISPLAY functions include:

1) "Title search" to find all files with the same title and display them as they were originally set up. This feature allows storage of text and graphics.

2) "Word search" locates files which contain a requested word, symbol, or phrase. A simple procedure can be used when attempting to recover data if you have forgotten the category you entered it under.

After every display you have these options:

1) Continue searching for the next item.

2) Begin a WORDSEARCH and list all appropriate file headings (file indexing).

3) Begin a word search and display complete files.

4) Return to a previous file display of the same title (this feature allows easy back and forth referral between text of files which are longer than one screen in length).

5) Begin a new file search.

The most noticeable shortcoming of other programs that I have seen is that the user is confined to one set format for a file once it is started. For example, if a file is set up as "Inventory" then the entire file would naturally lend itself to data formatted specifically for that purpose. Frequently the file space allowable is more than the user needs yet the remaining space cannot be used for other files.

SYNC

SOFTWARE PROFILE

Name: The ZX Data-Finder

Type: Data handling

System: 8K ROM; 16K RAM

Format: Listing

Summary: The most useful and economical data handling program I have yet found.

Price: $9.95

Manufacturer:

Thomas B. Woods
P.O. Box 64
Jefferson, NH 03583

Then, if data retrieval from a file named "Addresses" is desired, the user must LOAD it from yet another cassette. A few repetitions of this kind would lead to the conclusion that the computer is not geared to serious data retrieval.

In contrast, the ZX Data-Finder allows the user to design each file required to the exact specifications needed.

One LOAD would then give information from any number of different files instantly without constantly reLOADing from different tape files.

The amount of data the ZX Data-Finder can hold in just 16K is surprising. It has a carefully designed system which uses rather sophisticated string manipulation to squeeze the most out of the 16K pack.

The program listing also comes with extensive documentation which is a comprehensive course in how the Sinclair ZX81 or T/S 1000 handles data string manipulations. This provides an understanding of file handling which I have not found anywhere else.

In conclusion, this is the most useful and economical program dedicated to the task of data handling that I have found yet.

James P. Cripps, 4 Hackmatac St., Central Islip, NY 11722.

Starblasters

Dan Tandberg

8K ROM
16K RAM

In "Starblasters" you must defend a sector of space from the invading alien spaceships. Your weapon is a powerful ion beam. But beware!!! The aliens can fire back. They can blow up your ship or even overrun your sector. Although you have five excellent ships in your fleet, you must be quick, skillful, and sometimes lucky, to hold the aliens off.

After LOADing and RUNning the program, you will be offered three levels of difficulty to choose from. In the harder versions you must press "1" more quickly to fire your ion beam (lines 340 to 360). The aliens will fire at you more frequently each time you fire at them and miss (lines 130 and 310). They also fire at you more frequently each time you destroy one of their ships (lines 560 and 310). These effects are much more noticeable at the higher levels of difficulty. You guide your ship with the arrow keys: "6" for down and "7" for up. The pauses at the end of each wave of aliens or after losing the game can be ended by pressing any key (except the SHIFT key). Press BREAK when you wish to stop playing.

The dramatic "ion beam" effect (lines 110, 160, and 620) is produced with long strings of characters which are neatly sliced to the proper length and then rapidly printed one over the other using a single PRINT AT statement. Even if you do not try the entire game program, you will enjoy experimenting with this effective visual display technique. ■

Dan Tandberg, 4130 Coe Dr., N.E., Albuquerque, NM 87110.

Line notes:
80: YOU FIRE.
150: ALIEN FIRES.
190: MOVE.
380: YOU HIT.
390: Inverse space, inverse period (2), inverse space; inverse period (4); inverse period, inverse space (4); inverse period, inverse space (2), inverse period; inverse period, inverse space (2), inverse period; inverse space (4); inverse space (4).
470: ALIEN HIT.
480: Inverse space, inverse period (2), inverse space; inverse period (4); inverse period, inverse space (2), inverse period; inverse space (4); inverse period, inverse space (2); inverse period; inverse period; inverse space (2); inverse period; inverse space (4); inverse space (4).
590: OVERRUN.
600: Inverse space, inverse period (2), inverse space; inverse period (4); inverse period, inverse space (2), inverse period; inverse space (4); inverse period, inverse space (2), inverse period; inverse period, inverse space (2), inverse period; inverse space (4); inverse space (4).
700: SET POSITIONS.
750: RESET YOUR POSITION.
800: SETUP.
830: Inverse space (4), STARBLASTERS, inverse space between each letter, inverse space (5).
850: Inverse space (32).
880: LONG STRINGS.
890: 6 (32).
900: F (32).
910: Inverse + (32).
920: Inverse = (32).
930: Inverse − (32).
940: G (32).
950: Inverse period (32).
960: 7 (32).
970: Inverse space (32).
980: SHORT STRINGS.
990: Inverse <, inverse zero, inverse >.
1000: Inverse <, inverse =, inverse >.
1010: Inverse space (3).
1020: INITIALIZE.
1090: STARS.
1120: Inverse *.
1130: Inverse period.
1140: Inverse period.
1170: ALIENS WIN.
1270: EARTH WINS.
1370: INSTRUCTIONS.
1590: END.

```
 10 REM "STARBLASTERS"
 20 GOSUB 1370
 30 LET TOTAL=0
 40 LET WAVE=1
 50 GOSUB 800
 60 SLOW
 70 GOTO 190
 80 REM YOU FIRE
 90 LET CAT=29-C
100 LET U=C+3
110 PRINT AT R,U;A$( TO CAT);AT
 R,U;C$( TO CAT);AT R,U;E$( TO C
AT);AT R,U;F$( TO CAT);AT R,U;G$
( TO CAT);AT R,U;X$( TO CAT)
120 IF R=RA THEN GOTO 470
130 LET FIRE=FIRE+(.4-D/10)
140 RETURN
150 REM ALIEN FIRES
160 PRINT AT RA,0;J$( TO CA);AT
 RA,0;H$( TO CA);AT RA,0;J$( TO
 CA);AT RA,0;H$( TO CA);AT RA,0;I
$( TO CA);AT RA,0;X$( TO CA)
170 IF R=RA THEN GOTO 380
180 RETURN
190 REM MOVE
200 LET RAX=RA
210 LET CAX=CA
220 LET RX=R
230 LET CX=C
240 LET C=C+1
250 LET CA=CA-1
260 LET RA=RA+(RND<.5 AND RA<18
)-(RND>.5 AND RA>2)
270 PRINT AT RAX,CAX;R$;AT RA,C
A;Z$
280 LET R=R+(INKEY$="6" AND R<1
8)-(INKEY$="7" AND R>2)
290 PRINT AT RX,CX;R$
300 PRINT AT R,C;Y$
310 IF RND<(FIRE+DIFF) THEN GOS
UB 150
320 IF C>=CA THEN GOTO 590
330 REM DELAY FOR FIRE
340 FOR I=1 TO D
350 NEXT I
360 IF INKEY$="1" THEN GOSUB 80
370 GOTO 190
380 REM YOU HIT
390 PRINT AT R,C;"     ";AT R,C;
"     ";AT R,C;"     ";AT R,C;"
";AT R-1,C;"     ";AT R+1,C;"
";AT R-1,C;"     ";AT R+1,C;"
"
400 LET R=RA-(RA>=10)*INT (RND*
D+2)+(RA<10)*INT (RND*D+2)
410 LET C=0
420 LET SHIPS=SHIPS-1
430 PRINT AT 21,3;"SHIPS= ";SHI
PS
440 IF SHIPS<=0 THEN GOTO 1170
450 LET FIRE=0
460 GOTO 190
470 REM ALIEN HIT
480 PRINT AT R,CA;"     ";AT R,C
A;"     ";AT R,CA;"     ";AT R,CA;
"     ";AT R-1,CA;"     ";AT R+1,C
A;"     ";AT R-1,CA;"     ";AT R+1
,CA;"     "
490 LET RA=R-(R>=10)*INT (RND*8
)+(R<10)*INT (RND*8)
500 LET CA=28
510 LET ALIENS=ALIENS-1
520 PRINT AT R,C;R$
530 LET C=0
540 PRINT AT 21,20;"ALIENS= ";A
LIENS;" "
550 IF ALIENS<=0 THEN GOTO 1270
560 LET DIFF=DIFF+.3/(D*WAVE*5)
570 LET FIRE=0
580 GOTO 190
590 REM OVERRUN
600 PRINT AT R,C;"     ";AT R,C;
"     ";AT R,C;"     ";AT R,C;"
";AT R-1,C;"     ";AT R+1,C;"
";AT R-1,C;"     ";AT R+1,C;"
"
610 PRINT AT RAX,CAX;R$;AT RA,C
A;Z$
620 IF RND>.5 THEN PRINT AT RA,
0;J$( TO CA);AT RA,0;H$( TO CA);
AT RA,0;J$( TO CA);AT RA,0;H$( T
O CA);AT RA,0;I$( TO CA);AT RA,0
;X$( TO CA)
630 LET RAX=RA
640 LET CAX=CA
650 LET CA=CA-1
660 LET RA=RA+(RA<=9)-(RA>11)
670 IF CA<=0 THEN GOTO 1170
680 GOTO 610
690 REM END OF OVERRUN
700 REM SET POSITIONS
710 LET RA=2+2*INT (RND*8)
720 LET CA=28
730 PRINT AT 21,20;"ALIENS= ";A
LIENS
740 RETURN
750 REM RESET YOUR POSITION
760 LET R=RA-(RA>=10)*INT (RND*
6)+(RA<10)*INT (RND*6)
770 LET C=1
780 PRINT AT 21,3;"SHIPS= ";SHI
PS
790 RETURN
800 REM SETUP
810 FAST
820 CLS
830 PRINT AT 0,0;"  S T A R B
L A S T E R S  "
840 FOR I=1 TO 20
850 PRINT AT I,0;"
                "
860 NEXT I
870 PRINT AT 20,15;CHR$ (128+CO
DE STR$ D)
880 REM LONG STRINGS
890 LET A$="
                "
900 LET C$="
                "
910 LET E$="
                "
920 LET F$="
                "
930 LET G$="
                "
940 LET H$="
                "
950 LET I$="
                "
960 LET J$="
                "
970 LET X$="
                "
980 REM SHORT STRINGS
990 LET Y$="  O  "
1000 LET Z$="  =  "
1010 LET R$="  "
1020 REM INITIALIZE
1030 LET SHIPS=5
1040 LET FIRE=0
1050 LET DIFF=0.1
1060 LET ALIENS=WAVE*5
1070 GOSUB 700
1080 GOSUB 750
1090 REM STARS
1100 RAND
1110 FOR I=1 TO 10
1120 PRINT AT 1+INT (RND*19),INT
 (RND*31);"."
1130 PRINT AT 1+INT (RND*19),INT
 (RND*31);"."
1140 PRINT AT 1+INT (RND*19),INT
 (RND*31);"."
1150 NEXT I
1160 RETURN
1170 REM ALIENS WIN
1180 FAST
1190 LET TOTAL=TOTAL+WAVE*5-ALIE
NS
1200 CLS
1210 PRINT AT 4,3;"YOU FAILED---
"
1220 PRINT AT 8,3;"THE ALIENS GO
T THROUGH."
1230 PRINT AT 12,3;"YOU DESTROYE
D ";TOTAL;" SHIPS."
1240 PRINT AT 21,3;"(PUSH TO TRY
 AGAIN.)"
1250 PAUSE 10000
1260 GOTO 30
1270 REM EARTH WINS
1280 FAST
1290 LET TOTAL=TOTAL+WAVE*5
1300 CLS
1310 LET WAVE=WAVE+1
1320 PRINT AT 8,3;"CONGRATULATIO
NS---"
1330 PRINT AT 12,3;"A SUCCESSFUL
 DEFENSE."
1340 PRINT AT 21,3;"(BUT WAVE "
WAVE;" IS ON THE WAY.)"
1350 PAUSE 500
1360 GOTO 50
1370 REM INSTRUCTIONS
1380 FAST
1390 CLS
1400 PRINT """STARBLASTERS"""
1410 PRINT
1420 PRINT
1430 PRINT
1440 PRINT "USE KEYS 6 AND 7"
1450 PRINT "TO STEER EARTHSHIPS.
"
1460 PRINT
1470 PRINT "USE KEY 1"
1480 PRINT "TO BLAST ALIENS."
1490 PRINT
1500 PRINT
1510 PRINT "DIFFICULTY:"
1520 PRINT "1 IS HARD"
1530 PRINT "2 IS MEDIUM"
1540 PRINT "3 IS EASY"
1550 PAUSE 10000
1560 LET D=VAL INKEY$
1570 IF D>3 OR D<1 THEN GOTO 155
0
1580 RETURN
1590 REM END
```

Vu-Calc

Ken Uston

In "spread sheet" programs, one of the most well-known of which is Visi-Calc, we expect to be able to handle budgeting, whether personal or for small businesses, to work out complex mathematical problems, and to have the flexibility to accomplish other tasks such as calculating compound interest tables and recording the answers. Vu-Calc successfully meets these requirements.

Vu-Calc, developed for the Timex/Sinclair 1000 with 16K RAM, displays a table of 36 columns (numbered 01 through 36) and 26 rows (designated A through Z). Each of the 936 boxes can store up to eight characters, alpha or numeric. The screen displays 27 boxes at a time, three columns by nine rows. The "window" to the table scrolls rapidly, however, in any of four directions, allowing easy visual access to the entire table.

The user may input up to 40 formulas with up to 32 characters. Any of the boxes in the table can be used to store the answers. We can include in the formula:

1) The four basic arithmetic operations and exponents.

Ken Uston, Jockey Club #422, Las Vegas, NV 89109.

2) References to any of the boxes in the table, from the very first (upper left) box "A01," to the last (lower right) box, "Z26."

3) Constants such as A, B, X, Y, or Z, which can be assigned different values (these are particularly helpful in answering "what if"-type questions).

For any of the formulas, it is possible to generate a series of answers for each of the boxes in a given row or column. The answers can either be "absolute," i.e., the formula will be repeated with the same box numbers therein, or "relative," i.e., the box numbers are incremented by 1 as the program progresses to each consecutive box. Thus, if the formula for A02 is "A01+10", under the "relative" option each box through A36 will contain a value that is 10 greater than the previous box.

When the program is LOADed, the main menu appears and gives the user the options: to begin with an empty table, to continue working with the existing table with the information contained thereon, to save the program on the cassette with the existing table data, or to save the program with no table data.

The program has a number of helpful options, such as repeating formulas already typed in for other boxes, moving the cursor immediately to the first box (A01), and, for those users who have a printer, to print the contents of the screen.

Uses for VU-CALC

Vu-Calc is helpful in applications where the user must prepare spread sheets or matrixes which require mathematical operations. Here are some examples:

1) Let's say that you want to calculate the cost of 15 different items for each of the next 33 years (through the year 2015), assuming an annual inflation rate of 9 percent. We will list the general steps necessary to do this so you can get a

SYNC

SOFTWARE PROFILE

Name: Vu-Calc

Type: Spreadsheet

System: 8K ROM; 16K RAM

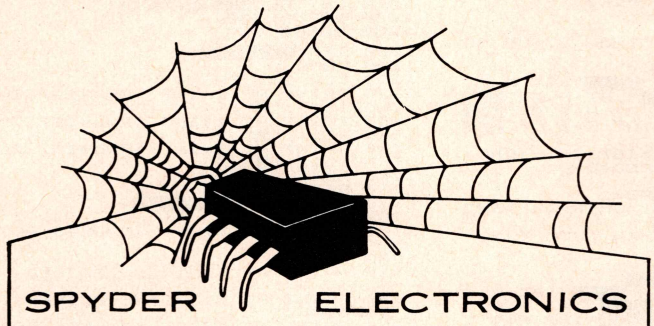
Format: Cassette

Summary: Potentially a valuable tool for many owners of the T/S 1000

Price: $19.95

Manufacturer:

Timex Computer Corporation
Waterbury, CT 06725



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clearer picture of how Vu-Calc works:

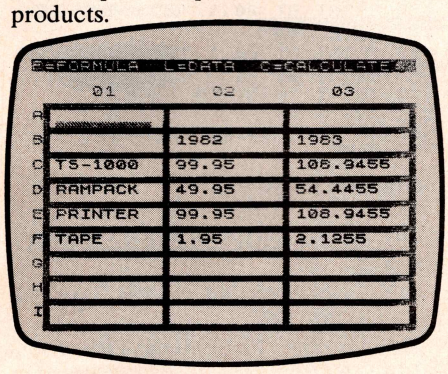
a) Enter the names of the 15 products in the first column, in boxes C1 through Q1.

b) Enter the year in the second row of the program, putting 1982 in B02, 1983 in B03, and so on, until 2015 in B35.

c) Enter the current cost of each of the items in the second column, in boxes C02 through Q02.

d) For Box C03, enter the formula "C02*1.09". Use the "relative" option to extend this through C35, effectively compounding the cost for each of the next 33 years at a 9 percent increase.

e) Repeat Step 4 for the 14 other products.



	01	02	03
A			
B		1982	1983
C	TS-1000	99.95	105.9455
D	RAMPACK	49.95	54.4455
E	PRINTER	99.95	108.9455
F	TAPE	1.95	2.1255
G			
H			
I			

f) Hit "C" and the data will be calculated and posted to the appropriate boxes in the table. See the sample printouts below.

2) Another use for Vu-Calc is keeping track of income and expenses, whether for personal or business use. For example, a dozen or more line items could be kept on each row, identified in the first column by a letter. The other columns could represent months, weeks, or days.

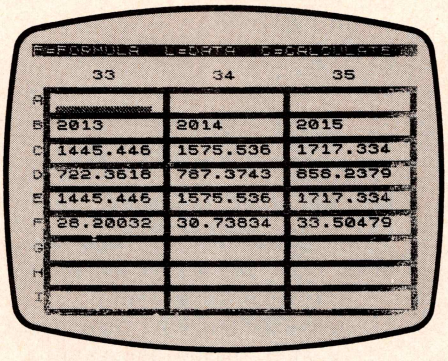
Although the limitation of 32 characters per formula makes it impossible to add 12 months to get annual totals, sub-totals such as quarterly data can be used. These can be added to derive yearly totals.

The formulas can be set up to add horizontally for line item totals and vertically for the period totals.

3) Using a similar format, Vu-Calc could be used for individual budget control. Budgeted amounts for various types of expenditures could be posted to every third column. Then actual information would be entered, as it become available. Formulas could be entered to calculate, for every third column, the amount, for each item, by which the budget was exceeded or (if you are thrift) undercut.

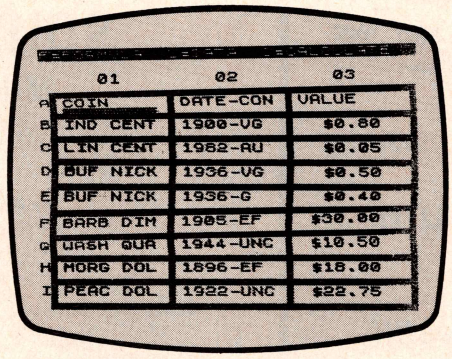
4) We could calculate the value of various investments at varying rates of appreciation or depreciation.

In summary, Vu-Calc is potentially a valuable tool for many owners of the Timex/Sinclair 1000. The uses mentioned



	33	34	35
A			
B	2013	2014	2015
C	1445.446	1575.536	1717.334
D	722.3618	787.3743	858.2379
E	1445.446	1575.536	1717.334
F	28.20032	30.73834	33.50479
G			
H			
I			

here merely scratch the surface. Other jobs to which Vu-Calc may be assigned are limited only by the creativity and imagination of the user. ■



	01	02	03
A	COIN	DATE-CON	VALUE
B	IND CENT	1900-VG	$0.80
C	LIN CENT	1982-AU	$0.05
D	BUF NICK	1936-VG	$0.50
E	BUF NICK	1936-G	$0.40
F	BARB DIM	1905-EF	$30.00
G	WASH QUA	1944-UNC	$10.50
H	MORG DOL	1896-EF	$18.00
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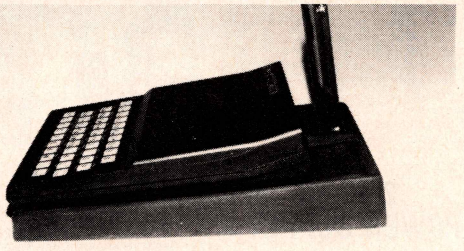

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8K Updates

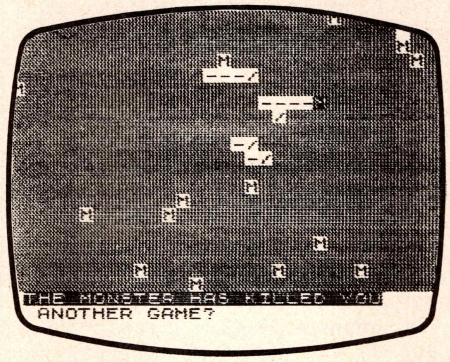
In the first issues of *SYNC* the programs were all for the 4K ROM. When the 8K ROM became available, we tried wherever possible to provide listings for both ROMs. Since we have had requests from readers for updated versions of some of the programs we published earlier, we will include these from time to time.

Forest Treasure

Paul Frahm

In Forest Treasure a treasure (shown as a blank space) is hidden in the forest. You (shown as a pound sign) are searching for it. Enchanted walls which are invisible may throw you off into a different direction. Monsters (shown as M) may pounce on you, steal the treasure, or kill you. Then you lose. However, they can even duplicate themselves. If you get the treasure, you win. You control your movements by U, D, R, L and then press ENTER. Entering S will exit you from the program.

Paul Frahm, 21123 Dettmering, Matteson, IL 60443.




```
 10 FOR I=1 TO 20
 20 FOR J=1 TO 32
 30 PRINT "▒";
 40 NEXT J
 50 PRINT
 60 NEXT I
 70 DIM B(75)
 80 PRINT AT 20,6;"FOREST TREAS
URE"
 90 LET E=INT (RND*20)
100 LET F=INT (RND*32)
110 LET T=INT (RND*659)
120 POKE PEEK 16396+256*PEEK 16
397+T,0
130 FOR I=1 TO 75
140 LET B(I)=INT (RND*659)
150 NEXT I
160 LET M=INT (RND*659)
170 IF M/33=INT (M/33) THEN GOT
O 160
180 POKE PEEK 16396+256*PEEK 16
397+M,50
190 IF M=T THEN GOTO 490
200 LET H=F+33*(E-1)
210 IF H/33=INT (H/33) THEN GOT
O 380
220 LET N=PEEK 16396+256*PEEK 1
6397+H
230 IF PEEK N=50 THEN GOTO 460
240 POKE N,12
250 IF H=T THEN GOTO 430
260 INPUT A$
270 PRINT AT 20,1;"
```

```
280 IF A$="S" THEN STOP
290 POKE N,22
300 FOR I=1 TO 75
310 IF B(I)=H THEN GOTO 380
320 NEXT I
330 IF A$="R" AND F<32 THEN LET
F=F+1
340 IF A$="L" AND F>1 THEN LET
F=F-1
350 IF A$="D" AND E<20 THEN LET
E=E+1
360 IF A$="U" AND E>1 THEN LET
E=E-1
370 GOTO 160
380 LET F=F+(INT (RND*9)-5)
390 LET E=E+(INT (RND*9)-5)
400 POKE PEEK 16396+256*PEEK 16
397+B(I),24
410 PRINT AT 20,1;"OOPS, YOU RA
N INTO A WALL"
420 GOTO 160
430 POKE PEEK 16396+256*PEEK 16
397+T,141
440 PRINT AT 20,1;"YOU HAVE TAK
EN THE TREASURE"
450 GOTO 510
460 POKE PEEK 16396+256*PEEK 16
397+H,178
470 PRINT AT 20,1;"THE MONSTER
HAS KILLED YOU"
480 GOTO 510
490 PRINT AT 20,1;"THE MONSTER
HAS STOLEN THE"
500 PRINT AT 21,1;"TREASURE";
510 PRINT "ANOTHER GAME?"
520 INPUT B$
530 CLS
540 IF CODE B$=62 THEN RUN
550 STOP
```

Graphics notes:

30: A

410: inverse: OOPS, YOU RAN INTO A WALL

440: inverse: YOU HAVE TAKEN THE TREASURE

470: inverse: THE MONSTER HAS KILLED YOU

490: inverse: THE MONSTER HAS STOLEN THE

500: inverse: TREASURE

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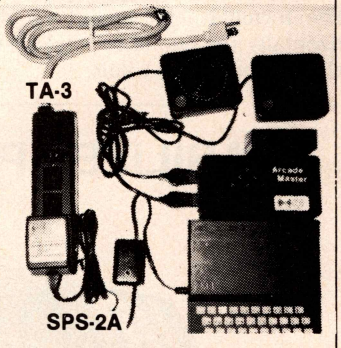

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Defuse

Raymond Fowkes

You are in a one million room building which has a bomb hidden somewhere inside. Fortunately, you have a bomb detector that registers a signal that get stronger as you get closer.

Enter the listing and press RUN and ENTER. The type in the coordinates of the room you want to test (length, width, height from 0 to 99) and proceed according to the signal you receive. You have 200 seconds before the building blows up.

To edit in 1K you must LIST the line, press CLEAR and ENTER and then EDIT. Do your editing and hit ENTER.

```
 10 RAND
 20 LET A=INT (RND*100)
 30 LET B=INT (RND*100)
 40 LET C=INT (RND*100)
100 PRINT AT 19,0;"L   W   H
SECONDS  SIGNAL"
110 PRINT
120 FOR S=10 TO 200 STEP 10
130 INPUT D
140 PRINT D;
150 INPUT E
160 PRINT TAB 4;E;
170 INPUT F
200 PRINT TAB 8;F;S;TAB 23;1E4-
(ABS (A-D)+ABS (B-E)+ABS (C-F))*
29
210 SCROLL
215 SCROLL
220 IF A=D AND B=E AND C=F THEN
GOTO 290
230 NEXT S
270 PRINT "*BOOOMMM* IT WAS AT
";A;",";B;",";C
280 GOTO 300
290 PRINT "BOMB DEFUSED"
300 PAUSE 4E4
310 CLS
320 RUN
```

Raymond Fowkes, PO Box 336, Coalinga, CA 93210.

```
 L   W   H    SECONDS   SIGNAL
 40  0   0      10       6636
 20  40  0      20       8376
 20  60  0      30       8434
 20  52  0      40       8666
 20  50  0      50       8666
 20  51  16     60       9159
 20  51  30     70       9565
 20  51  46     80       9971
 20  51  45     90       10000
BOMB DEFUSED
```

Mastermind

Raymond Fowkes

In Mastermind the computer selects from six colors a code of four letters. You must discovered this code in no more than 9 guesses. Input your guess as a series of four letters (representing the colors ROYGBW). The computer will match your letters one by one with the selected code. A black peg shows that your guess was right in color and position; a white peg, that your guess was right in color, but wrong in position. Continue until you guess the code or run out of guesses.

Continued on pg. 104

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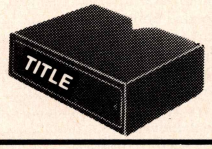

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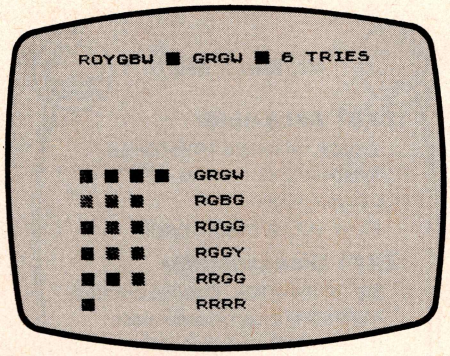



```
 10 LET A=4
 20 DIM A$(A)
 30 DIM B$(A)
 40 FOR D=SGN A TO A
 50 LET A$(D)="ROYGBW"(VAL "RND
*5+1")
 60 NEXT D
 70 PRINT "ROYGBW ■■■■■■■■■■"
 80 FOR D=19 TO INT PI STEP -2
 90 LET B=NOT A
100 INPUT B$
110 PRINT AT D,9;B$
120 LET C$=A$
130 FOR E=SGN A TO A
140 IF B$(E)<>C$(E) THEN GOTO 1
90
150 PRINT AT D,B;"■"
160 LET B=B+2
170 LET B$(E)="▒"
180 LET C$(E)="■"
190 NEXT E
200 IF B=A+A THEN GOTO 310
210 FOR E=SGN A TO A
220 FOR F=SGN A TO A
230 IF C$(E)<>B$(F) THEN GOTO 2
80
240 PRINT AT D,B;"▒"
250 LET B=B+2
260 LET B$(F)="▒"
270 GOTO 290
280 NEXT F
290 NEXT E
300 NEXT D
310 PRINT AT NOT A,NOT A;"WRONG
 " AND D=SGN D;TAB A+A;" ";A$;
320 IF D<>SGN D THEN PRINT INT
VAL "11-D/2";" TRIES"
```

70: inverse space (8). 180: inverse space.
150: inverse space. 240: A.
170: A. 260: A.

Hangman

Raymond Fowkes

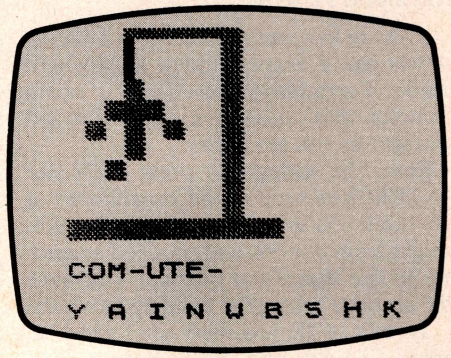
After entering and RUNning the classic game of Hangman, the first player inputs a word of up to 18 characters (32 for 2K). The screen is then cleared. The second player begins trying to discover the secret word by entering letters likely to be in the word. All correct letters are printed where they occur in the word and any others are printed in the center of the screen and a body part is added to the figure on the gallows.

Typing in the lines below will cause the program to accept characters without pressing ENTER after each. Spaces, however, will not be recognized:

190 PAUSE 4E4
195 LET C$=INKEY$
Delete line 140

Graphics line notes:

40: D (6)
50: 5, A
60: 5, A
80: A
100: A (11)
240: inverse space.
300: A




```
 10 PRINT " INPUT WORD"
 20 INPUT A$
 30 CLS
 40 PRINT "          "
 50 PRINT "          "
 60 PRINT "          "
 70 FOR A=1 TO 7
 80 PRINT TAB 8;"■"
 90 NEXT A
100 PRINT "■■■■■■■■■■"
110 PRINT
120 LET B$=A$
130 LET F=NOT A
140 DIM C$(NOT F)
150 FOR B=F TO LEN A$-NOT F
160 PRINT "-";
170 NEXT B
180 FOR G=F TO 11
190 INPUT C$
200 LET D=NOT A
210 FOR A=NOT D TO B
220 IF C$<>A$(A) THEN GOTO 260
230 PRINT AT 12,A-1;C$
240 LET A$(A)="■"
250 LET F=F+1
260 LET D=F
270 IF F=B THEN STOP
280 NEXT A
290 IF D THEN GOTO 190
300 PRINT AT 14,G+2;C$;AT VAL "
344455567788"(G+NOT D),VAL "3324
31532415"(G+NOT D);"■"
310 NEXT G
320 PRINT AT G,NOT A;B$
```

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